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Autumnal Mecoptera of Southeastern United States[1]

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ABSTRACT

Thirty-three species of Panorpidae, two of Bittacidae and one of Meropeidae known to have an autumnal period of adult emergence in the southeastern United States are reviewed. Included are the following new species of *Panorpa*: *acuminata, bichai, choctaw, confinis, ferruginea, floridana, hispida, oconee, pachymera, planicola, rupeculana* and *scopulifera*. Rediscovery of *Panorpa neglecta* and *P. gracilis* is recorded, as well as range extensions for several other species. Observations on ecological occurrence are given for most species. A neotype is designated for *Panorpa rufescens* Rambur. *Panorpa venosa* Westwood is removed from synonymy of *P. rufescens*. All known autumnal species of the region are differentiated in a taxonomic key.

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INTRODUCTION

Many species of North American Mecoptera apparently are univoltine, with adults on the wing in late spring and summer. Numerous others for which an extended flight period has been somewhat vaguely described (e.g., "June - October") turn out to be bivoltine. Adults of *Panorpa anomala* and *P. helena*, for instance, appear in floodplain woods and later in more upland woods in eastern Kansas from about mid-May to early July and reappear in late August and early September. In most of July and August they are competely absent in habitats where they are common earlier and later. Laboratory rearing suggests that the smaller late-summer generation consists of the more rapidly maturing offspring of the spring generation and that more slowly developing individuals from eggs laid in spring (particularly late in spring) reach adulthood the next spring.

Flight periods of *Panorpa* appear to be correlated with fairly cool weather; bivoltine species in the southern United States have, in general, an earlier spring generation than those at the latitude of Kansas but a later second generation that is autumnal.

In contrast, adults of a few species have been collected more frequently in the autumn, while occasional specimens taken in spring are recorded. Such species include *Panorpa lugubris, P. nuptialis* and *P. rufa*, which comprise a structurally, phylogenetically distinct species group.

"Autumnal," as used here, refers to the calendar definition of autumn, 21 September to 22 December. However, depending on the location within the vast area under consideration, the autumnal equinox can be quite hot and summer-like or, conversely, cool and occasionally with chilly nights. And the winter solstice can vary from balmy in northern Florida to altogether wintery in, say, Missouri and Kentucky.

To study these autumnal species in their natural habitats and to determine whether there is an autumnal period of emergence in certain little-known species, I travelled to the southeastern United States in the fall of 1977 (21 September - 10 October). The following account reports the results of that trip and of occasional others, as well as data gathered from the study of various institutional and private collections.

The area covered by this report is from the Atlantic coast westward to approximately the 98th meridian (98°W) and southward from about the 39th parallel (39°N)—a line roughly indicated by Washington, D.C., Cincinnati, St. Louis and Kansas City. This southeastern quarter of the contiguous United States includes most of the Atlantic Coastal Plain, the Gulf Coastal Plain, the piedmont of the Appalachian Mountains (there being no autumnal records from the mountains), the lower Mississippi Valley and the Ozark Plateau.

Methods: Drawings were made with the aid of a camera lucida. Those that are shaded were made on coquille-board. When terminal segments were removed and dissected, the parts were subsequently mounted in polyvinyl alcohol (with lacto-phenol) on a point of 2-ply Bristol-board marked "in P.V.A." and placed on the pin beneath the specimen. This plastic mounting medium preserves the parts and protects them from dust but is soluble in warm water so that the parts can, in the future, be readily removed and studied "in the round."

Experience has shown that the usual textbook directions for pinning specimens are not suited to either scorpion-flies (Panorpidae) or hanging-flies (Bittacidae). Due to the backward deflection of the thoracic segments of scorpion-flies, a pin inserted vertically through the mesonotum usually emerges in front of the middle coxae, where the thorax is quite thin and weak. This often results in breakage of dried specimens at the level of the pin. I recommend pinning through the metanotum so the pin will emerge between the middle and hind coxae; this places the pin through the thickest, strongest part of the thorax. Bittacids pinned through the small thorax are ordinarily left with dangling long legs that are easily broken subsequently during the labelling process. Drying bittacids more or less flat in paper envelopes, with the legs arranged compactly, and then mounting them on the left side on a Bristol-board point overcomes this problem. Admittedly, specimens so prepared require more space in the collection, but they are also much more likely to remain intact over time.

Mr. Wesley (Wes) Bicha, of Oliver Springs, Tennessee, has been a very important contributor to our knowledge of the distribution of North American Mecoptera. In the lists of collection data hereinafter, most specimens taken by him are designated simply by "WB" as collector. My own collections are similarly indicated as made by "GWB."

Types: Most of the holotypes and allotypes and some of the paratypes of the new species described here are deposited in the Snow Entomological Museum (SEM) at the University of Kansas, Lawrence, Kansas. Most of the paratypes collected by Wes Bicha are returned to him (WB); paratypes of most new species are also deposited in the U.S. National Museum of Natural History, Washington, D.C. (USNM), the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (MCZ) and the Museum of Zoology, University of Michigan, Ann Arbor, Michigan (UMMZ).

ACKNOWLEDGMENTS

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THREE NEW TERMS

1. *Humeral spots.* In the following taxonomic descriptions of *Panorpa* species, reference is made to the dark brown bands and spots on the wings. Their pattern is usually consistent within a species, although examples of striking variation are known (e.g., in *P. debilis*). Since the fore wings often broadly overlap the hind wings and thus obscure them, in life as well as in specimens that have not had the wings spread, the pattern of the fore wings only is ordinarily described. The markings on the hind wings are generally less extensive than those of the fore wings.

Esben-Petersen (1921: 12, fig. 1) diagrammed a wing of *Panorpa* and gave names to various bands and spots, based in part on names used by earlier authors. Carpenter (1931: 220, fig. 3) followed Esben-Petersen in most of these names. He introduced the term "marginal spots" for two small spots between the costa and the subcosta or radius, in the humeral part of the wing. Esben-Petersen, however, had used "marginal spot" for an often much larger spot between the pterostigmal and basal bands (Fig. 1). Carpenter omitted this spot from his diagram, just as Esben-Petersen had omitted the smaller spots from his illustration.

To put an end to this confusion, I propose that the "marginal spots" in Carpenter's terminology be called *humeral spots* and that "marginal spot" be used as in Esben-Petersen's system. This is the terminology adopted hereinafter.

2. *Aedeagal hamulus.* This term is introduced to replace such cumbersome wording as "a short, thick, upturned process at base of aedeagus, below ventral valves" (Byers, 1973a: 368-369), or projections from the ventral parameres "fused basally to form two narrow elongate extensions" (Webb, 1974: 172). The structure, at the mid-ventral base of the aedeagus (Fig. 2, ah), usually has a less distinct connection to the ventral parameres than shown by Webb. It is almost always upturned, hence the term *aedeagal hamulus* (hook). In some species it has a single, blunt (rounded or truncate) tip; in others there are two pointed branches, diverging to varying degrees. Absent in still others but usually readily visible when present, the *aedeagal hamulus* has species-specific shapes and is, thus, a taxonomically useful structure. (Its function in those species that possess it has not been determined.)

3. *Basistylar flanges.* In males of most species of *Panorpa*, there is, on the ventro-mesal surface of each basistyle, a somewhat blade-like or fin-like projection against which the lateral process of the aedeagus abuts. These projections have been described as prominent humps, large lobes, prominent lobes, large humps, etc. (Carpenter, 1931); clearly, Carpenter noticed that the shapes of these structures varied among species while being fairly constant within a species. But a term that recognizes their essentially two-dimensional nature seems to me more accurately descriptive than "hump" or "lobe." Accordingly, I propose "basistylar flanges" (Fig. 2, bf). Their shape varies from low with virtually straight or truncate margin to wide and rounded, nearly semicircular.

SPECIES GROUPS

Most of the species of Panorpidae in the southeastern states can be assigned to four species groups based upon morphological similarities. Since these groups, with one exception, do not correspond to the species groups recognized by Carpenter (1931:221), they may be briefly characterized as follows:

Panorpa lugubris group. This is the *lugubris* group as defined by Carpenter (that is, *lugubris, nuptialis* and *rufa*), except that I have added one species (*floridana*). Abdominal segments 7 and 8 in the male are proportionately longer than in other regional Panorpas. The dististyles are slender in the apical half; the apex of the ninth tergum is narrowly rounded or acute; and the hypovalves of the ninth sternum are short and borne on a common pedicel. The axial portion of the genital plate in the female is thick and projects beyond the posterior margin of the distal plate. This group appears to have close relationships with several species in Mexico.

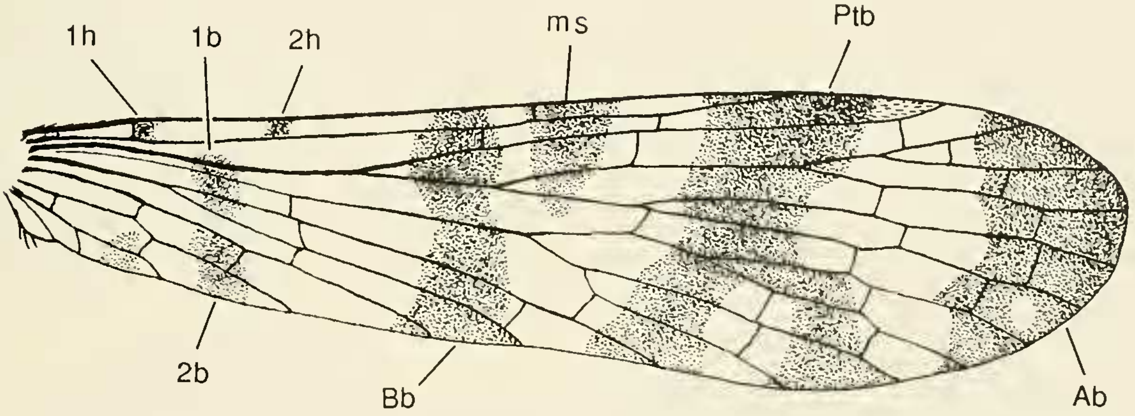


Fig. 1. Nomenclature of wing markings in *Panorpa*. Abbreviations: **Ab** - apical band, **Bb** - basal band, **Ptb** - pterostigmal band, **ms** - marginal spot, **lb** - first basal spot, **2b** second basal spot, **1h** - first humeral spot, **2h** - second humeral spot.

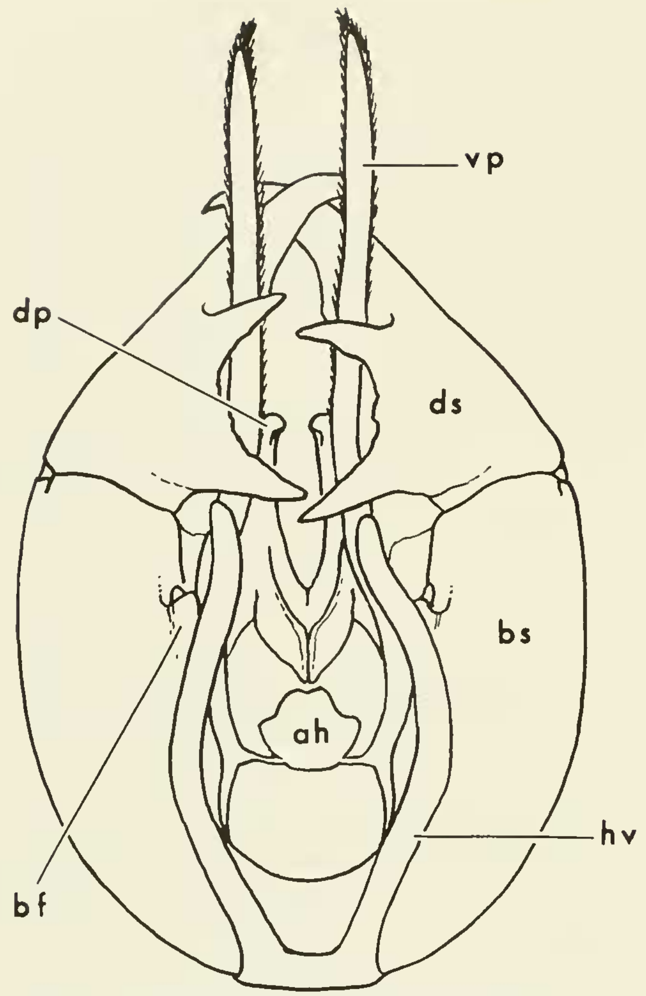


Fig. 2. Nomenclature of parts of genital bulb of male *Panorpa*. Abbreviations: **ah** - aedeagal hamulus, **bf** - basistylar flange, **bs** - basistyle, **dp** - dorsal paramere, **ds** - dististyle, **hv** - hypovalve (prolongation of ninth abdominal sternum), **vp** - ventral paramere.

Panorpa virginica group. Included in the *rufescens* group by Carpenter (1931), these species are characterized, in males, by long, slender hypovalves, ventral parameres extending between the dististyles, the aedeagal hamulus prominent but blunt and upturned apically, and the basal cups of the dististyles deep and opening generally mesad. In females, the basal plate of the genital plates is narrower than the distal plate, and there are well developed, darkly sclerotized laterotergites between the ninth abdominal tergum and the subgenital plate. In this group, besides *virginica*, are *neglecta*, *hungerfordi* and two new species, *choctaw* and *oconee*.

Panorpa banksiana group. These four species (*banksiana*, *dissimilis*, *gracilis* and *palustris*) are separated from Carpenter's *rufescens* group mainly on the basis of the males' shallow, ventrally-directed basal cups of the dististyles and the females' lack of anterior apodemes on the genital plate. *Panorpa carolinensis* and *P. longicornis* do not appear to belong to this group despite some conspicuous similarities in the females.

Panorpa rufescens group. Nearly all species in this group have essentially the same wing pattern as *rufescens* (i.e., apical band including some pale spots, pterostigmal band complete but not forked posteriorly, marginal spot usually interrupted between R_{2+3} and R_{4+5}, basal band interrupted near its mid-length, and first basal and first humeral spots present). A southeastern species lacking this pattern is *P. vernalis*, which has essentially unbanded wings. In males of the *rufescens* group, the basal cups of the dististyles are shallow with a narrow, darkly slcerotized border produced slightly as a dorso-mesal angle, or tooth, and with a row of short, thick, black setae along the dorsal margin near the base of the dististyle. There is no aedeagal hamulus. The ventral parameres are quite variable within the group but generally consistent within a species. Within the seasonal and geographical scope of this paper, the included species are *rufescens*, *ensigera*, *robusta*, *venosa* and *vernalis*, as well as several new species (*hispida*, *scopulifera*, *ferruginea*, *confinis*, *pachymera*, *acuminata*, *rupeculana* and *planicola*).

The *Panorpa nebulosa* group of Carpenter (1931) is made up of species outside the *lugubris* group in which males have no horn-like posterodorsal projection on the sixth abdominal segment. The wings usually have no complete bands or large spots, an uncommon condition in other species groups. But this is otherwise a diverse assemblage of species, as judged by details of male and female genitalic structures. With the exception of an October specimen of *nebulosa* from Missouri, there are no autumnal records of this group known to me from the southeastern states.

FAMILY MEROPEIDAE

Merope tuber Newman

Previously recorded from as far west as Columbia, Missouri, and eastern Minnesota (Byers, 1973b), *Merope tuber* has in recent years been collected in northeastern Kansas (Douglas Co.), eastern Oklahoma (Latimer Co.) northwestern Arkansas (Washington Co.), and eastern Iowa (Jones Co., outside the geographical scope of this paper). In Kansas, several individuals have been taken in Malaise traps set in the Breidenthal Reserve (University of Kansas), about two miles north of Baldwin City. The habitat is mixed deciduous woods near a stream that flows almost continuously, forming ponds in late summer in some years. The original collections were on 17 September 1981 (1m, 1f) and 7 October 1981 (1m, 1f), in a trap set for ichneumonids by David Wahl. Subsequent collections in various years have been within this span of dates and include specimens from Malaise traps I set considerably farther from the stream. The specimens trapped by Karl Stephan in Oklahoma were taken in August. Those collected by flight-intercept trap near Fayetteville, Arkansas, by Chris Carlton, are more nearly autumnal (5-12 September 1992).

FAMILY BITTACIDAE

Bittacus occidentis Walker

In some years, this is a common autumnal species in and near Lawrence, Kansas; but in other years it is seldom seen. Clearly attracted to lights but apparently not particularly to other insects concentrated there, it usually does not capture prey but hangs motionless on walls, window frames and other illuminated surfaces, flying from time to time when disturbed by moths, beetles and other insects. On 22 September 1964, I collected 12 males and 14 females at lights on one building of the University of Kansas. Setty (1940) mentioned the attraction of *B. occidentis* to lights, and I have recorded some of his further observations as well as other occurrences of this species at lights (Byers, 1954).

Perhaps it is only coincidental, but the three most recent years of conspicuous abundance of *B. occidentis* in Kansas have been seven years apart (1978, 1985, 1992). This is in agreement with the 1964 "outbreak" noted above. In 1992, the peak of flight activity was in late August and early September (27 Aug. -8 Sept.), not truly autumnal.

Bittacus occidentis has an unusually extensive range: from New York southward to South Carolina and Alabama and southwestward to Nebraska, southern Texas (e.g., Sinton, San Patricio Co., 7 Oct.) and Arizona. There are numerous summer records, yet *occidentis* seems to be primarily autumnal. Carpenter (1931) listed autumnal collections of *occidentis* from Washington, D.C., North Carolina (Raleigh) and Alabama (Auburn). In recent years, I have seen autumnal specimens from Missouri (Boone Co., Columbia, 24-25 Sept., 9-20 Oct.), North Carolina (Wake Co., 4 Nov.), and Oklahoma (Payne Co., 21-29 Sept., 3-10 Oct.), in addition to the southern Texas collection already mentioned. The collection of this bittacid near universities where entomology is taught is probably a result of the need for people with an interest in Mecoptera to be in school rather than away on a field trip.

Bittacus texanus Banks

Although primarily an autumnal species, *B. texanus* like the similar but smaller *B. occidentis* has been collected in late spring and summer as well. Having reported the species from Lawrence, Kansas, nearly 500 miles north of its previously known range (Byers, 1954), I searched for it yearly but in vain from 1956 to 1980 in the vicinity of Lawrence. Following a relatively cool summer of abundant and evenly-spaced rains in 1981, I found *texanus* on a south-facing slope near the dam at Clinton Lake, a reservoir 4 miles west of Lawrence. The insects were found most often in the shade of shrubs and small trees and, late in the day, in nearby sweet clover (*Melilotus*) and grasses about two feet high. About 75 adults were collected on 6, 7, 10 and 13 September.

I have watched for the species every year since 1981 in this same area, as well as in other apparently suitable places near Lawrence, in summer and autumn, but have not seen it again. *B. texanus* has not been found common anywhere but is known also from scattered localities in eastern Texas (Cameron, Cherokee, Nacogdoches, Travis and Wise counties in late September and October), and western New Mexico (a single individual, from El Morro National Monument). Carpenter (1931:264) recorded a single female of the species from Citrus Center, Florida (Glades Co., west side of Lake Okeechobee), but I think the locality-date label must have been in error.

FAMILY PANORPIDAE

Panorpa lugubris Swederus

Its black wings with contrasting scattered white spots make this a readily recognizable species. The dark reddish brown body is somewhat darker than that of the apparently closely related *P. rufa* Gray and *P. nuptialis* Gerstaecker. These three species have wing coloration unlike that of any other North American species except perhaps *P. americana*. In males of all three, the hypovalves are short and borne on a broad prolongation of the ninth abdominal sternum, and the corresponding ninth tergum is narrowly rounded apically (i.e., not divided into two apical lobes). The females of all three species have thick genital plates without terminal (posterior) lobes (Carpenter, 1931: plate 5, figs. 42-44). These and other characteristics, such as the very elongate seventh and eighth abdominal segments in males, give *lugubris*, *nuptialis* and *rufa* a strong resemblance to certain Mexican Panorpas. It seems likely that these three species entered southern United States from Mexico during a warm interglacial interval, sometime during the Pleistocene.

The known range of *P. lugubris* (Map 1) extends across the Atlantic and Gulf coastal plains from southeastern Virginia through North and South Carolina, Georgia, the northern half of Florida, southern Alabama, southeastern Mississippi, to eastern Louisiana (Livingston Parish, east of Baton Rouge). Carpenter (1935) reported *lugubris* from Dallas, Texas, and from an unspecified locality in New Mexico. Records available to me, however, indicate that the ranges of *lugubris* and *nuptialis* meet but do not overlap (Map 1). Most specimens seen were collected in September through December. There is, however, a smaller spring generation with adults on the wing from mid-April to early June. I have seen a few individuals taken in August and January. Many of the places where *lugubris* has been found have sandy soil and are unshaded or have only a sparse tree cover (cf. *P. rufa*).

Numerous adults of *P. lugubris* were collected in Suwanee Co., Florida, on 6 December 1977. Most of these were preserved at that time, but three males and two females were transported alive to my laboratory at the University of Kansas. Between 9 December and 11 January 1978, these adults were kept in a terrarium for observation of their behavior (GWB rearing lot no. 176). Feeding, mating and oviposition, as well as other behavior, were observed repeatedly during this 37-day period. The males died on 22 and 24 December but presumably had transformed from pupae several days before the females.

During daylight hours, both sexes displayed wing fanning (slow raising of the wings together with spreading them somewhat, then lowering them) and wing flicking (rapid, jerky movements during fanning), frequently accompanied by raising and lowering of the abdomen. Males often struck the venter of abdominal segment 7 against the substrate, and at times they held the hind wings against the sides of the abdomen while fanning the fore wings. Grooming included brushing the wings, chiefly their upper surfaces, and the abdomen with the hind legs, which were then rubbed together. The head and antennae were groomed with the fore legs, followed by rubbing these legs together.

Males did not produce a gelatinous salivary secretion to attract females, as in many other species, but once having fed they vigorously guarded small balls of ground beef provided. When other males approached, a guarding male, standing over the food, would strike laterally with his genital bulb, with the dististyles held widely apart. When a female approached, the guarding male sometimes left the food briefly to grasp the female's abdomen and subsequently bring the genitalia into appropriate position. With the female's body approximately perpendicular to his own and above his back, the male turned his elongate abdomen to one side, bringing the genital bulb nearly 270 degrees around from its initial orientation. The costal margin of the female's wing was clamped in the notal organ, although the wings were held somewhat roof-like above her abdomen but beneath the male's wings. Copulations observed lasted from 6 to 62 minutes, with the female feeding from time to time.

Both the female and the male were usually almost motionless, but the male occasionally fanned his wings. Mating occurred during daylight; after sunset the insects climbed up from two to four inches on clumps of grass or plant stems in the terrarium and rested with vertical orientation (as in *P. nuptialis* and most Mexican species).

Prior to oviposition the female probed in the substrate with her ovipositor, presumably testing for pre-existing cavities, level of soil moisture, etc. Three small dishes of soil about 10 mm. deep were offered for oviposition: sand, sand mixed with humus soil, and humus (such as most other species would use for oviposition). The females laid their eggs only in the humus, not in sand or sandy soil as anticipated. One female was observed to probe and oviposit in the humus, after which she cleaned her ovipositor with her hind legs then went to the dish with sand and humus, probed for a few minutes, and returned to the dish with humus only and resumed ovipository behavior.

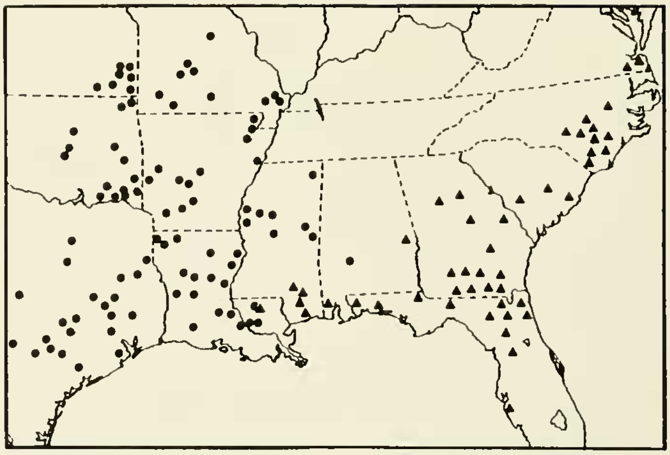
Size of egg clusters and depth of oviposition were variable. Representative clusters contained 12, 18, 34, 35, 37, 37 and 42 eggs and were from 5 to 10 mm. below the soil surface. Mampe and Neunzig (1965: 848) found eggs of *P. lugubris* usually laid singly. Eggs were usually held together by a secretion from the female that was fluid on freshly deposited eggs but which may be the source of an uneven "felt" of matted, fibrous-looking material adhered to the chorion after several hours (in contrast to the smooth chorion of *P. nuptialis* or the "network" of material covering the eggs of several other *Panorpa* species). Pale cream-colored when first laid, the eggs became gray after a few hours, swelled conspicuously to nearly a millimeter in length and eventually darkened to almost black shortly before hatching. Duration of the egg stage was about 7 to 9 days under laboratory conditions.

Upon hatching, larvae were light gray (darker than most first-instar Panorpas I have seen), the head capsule also light gray except for the blackish frons with black egg-tooth and the dark brown mandibles and black eyes. Fed on small nymphs of *Blatella* and on adult *Drosophila* (the preferred food), the larvae grew rapidly, attaining the second instar in four days, the third instar in four more days, and the fourth instar four to five days later. That is, from hatching to beginning of the last larval instar was two weeks or a little less, when abundant food was provided. A week after attaining the fourth instar, larvae reached full size of approximately 17 mm. length (cf. Mampe and Neunzig, 1965: 844) and ate small insects so rapidly that I began feeding them ground beef. By 11 January, many of the larvae had entered pre-pupal diapause (i.e., had ceased feeding and had become quiescent) and the last adult female died; the insects were then preserved and observations discontinued.

The mature larva of *Panorpa lugubris* has been described in detail by Mampe and Neunzig (1965) and by Boese (1973).

Panorpa nuptialis Gerstaecker

Largest and arguably the most colorful North American scorpion-fly, *Panorpa nuptialis* is also the westernmost of our species, if one disregards a couple of questionable records from Utah (Gurney, 1937, 1938) and New Mexico (Carpenter, 1935). It is a common and widespread autumnal species found from southeastern Kansas southward through Oklahoma to southern Texas and eastward to the Mississippi River in Missouri and Arkansas and, farther south, to western Alabama (Map 1). Most collection records are for October, but the species has also been found throughout September and November and, in the southern part of its range, in early December. Carpenter (1931) reported a mid-July occurrence in southeastern Kansas.



Map 1. Geographical distribution of *Panorpa nuptialis* (circles) and *Panorpa lugubris* (triangles). Each symbol represents one or more autumnal collections in a county (or parish, in Louisiana).

Several morphological characters (e.g., the shape of the ninth abdominal tergum, hypovalves of the ninth sternum, shape of dististyles, and relatively elongate abdominal segments in males, and the shape of the genital plates in females) indicate a close relationship of *P. nuptialis* with *P. lugubris*. These same characters suggest a slightly less close relationship of both these species to *P. rufa* Gray. All three (and *P. floridana*, described below) comprise a species group that has many similarities to several Mexican species and that is distinct from other scorpion-flies of eastern United States and Canada.

Habitats in which *P. nuptialis* has been found show that the species is less dependent on moisture than most of its nearctic congeners. I have collected it in grasses in sparse woods and in weedy growth at the edges of woods but also in open grasslands (pastures and even occasionally-mowed roadside grass) and in cultivated fields adjacent to woods (soybeans, cotton, etc.). Unable to find *nuptialis* in apparently suitable habitats on the Mississippi floodplain, I supposed it might have been eradicated there by prolonged use of various insecticides. Other aspects of the habitat of this species, as well as general biology of adults, eggs, larvae and pupae, can be found in an earlier paper (Byers, 1963).

Panorpa rufa Gray

Not a rare species but an elusive one, *P. rufa* is known today—more than 150 years after it was named and described—from only eighteen localities (Map 2). Although I have searched for it at some of these places, in various years, I have never succeeded in finding it. There is a single collection record for 10 May at Southern Pines, North Carolina (Carpenter, 1931), but this is typically an autumnal species, virtually all dates of collection being between the middle of October and 20 December.

All the sites from which *P. rufa* is currently known have sandy or sandy-loam soil, and at least some are characterized by rather sparse longleaf or loblolly pine woods, or a mixture of pine and oak, with grasses the commonest ground cover. (In Bay Co., Florida, for example, the habitat was a plantation of *Pinus clausa* on sand hills.) If one may extrapolate from knowledge of *P. nuptialis* and *P. lugubris*, the other members of the species group to which *rufa* belongs, the insects should be sought late in the day and fairly near the ground, and they are likely to be vertically oriented on slender plant stems, rather than on more horizontal leaf surfaces as in most of our Panorpas.

Panorpa rufa has been found in the following southeastern states and counties on the dates indicated: Alabama, Conecuh Co., 14 Nov.; Lee Co., 20 Oct. and 2 Nov.; Macon Co., 26 Nov.; Mobile Co., 8 Oct. and several dates between 1 and 23 Nov.; Florida, Alachua Co., 21 Oct.; Bay Co., 7 Dec.; Gulf Co., 1 Nov.; Holmes Co., 14 Nov.; Okaloosa Co., 3 Nov.; South Carolina, Clarendon Co., 25 Oct.; North Carolina, Moore Co., various dates from 10 to 20 Oct.; New Hanover Co., 25 Dec. The types are from an unspecified locality in Georgia. Since they were collected prior to 1833, I have put a spot on Map 2 near Savannah, a center of entomological and other cultural activity in the late 18th and early 19th centuries. The published record for Tennessee (Cole and Gillespie, 1950) is omitted from the map because I consider it to be based on a misidentified specimen (a single female, collected in June, in the Great Smoky Mountains). In his study of the Mecoptera of eastern Tennessee, Caron (1967) was unable to find this specimen and also concluded that the record was in error.

See discussion of structural details under *Panorpa floridana*.

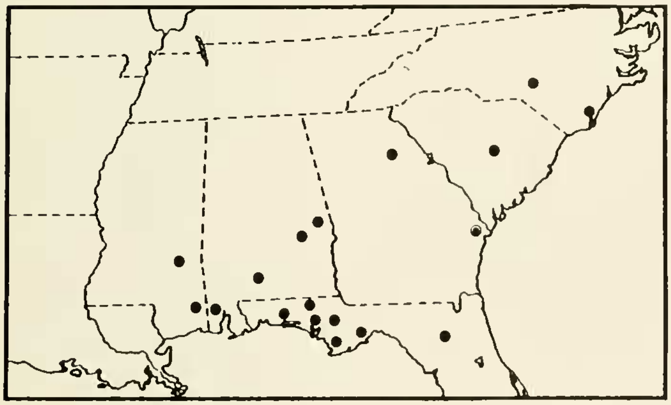
Panorpa floridana new species

Description based on 3 males, 2 females, pinned (terminal segments of one female originally slide-mounted).

Head: Dorsum, frons and rostrum dark yellowish brown to reddish brown; dark brown to black ring around each ocellus. Scape and pedicel dark yellowish brown; flagellum dark blackish brown with 41-45 flagellomeres (41 in left antenna, 45 in right, in holotype).

Thorax: Dorsum dull brown, mostly finely pubescent, with scattered short, black setae, but nearly glabrous and darker brown near bases of wings. Pleural surfaces, mera and coxae dull brown, finely pubescent, with widely scattered pale hairs; these hairs longest and most dense on anterior surfaces of coxae. Legs and tarsi dark yellowish brown except fifth tarsomeres dark brown.

Wings tinged with yellowish brown; bands and spots brown. Apical band diffuse, with broad pale zones bordering all included cross-veins and pale spots in cells slightly before apical margin. Pterostigmal band usually complete (interrupted between M_{1+2} and M_4 in right front wing of male paratype), not branched but with roughly triangular spot at posterior margin near M_4. Marginal spot extending from C to R_{2+3}. Basal band entire but strongly constricted at M. First and second basal spots present, and a conspicuous, more proximal spot in fore wing, from A_1 to A_3. No humeral spots.



Map 2. Geographical distribution of *Panorpa rufa*. Solid circles represent one or more autumnal collections in a county; circle enclosing a spot represents the holotype of this species from an unknown locality in Georgia at an unknown date prior to 1833.

Abdomen of male: Terga 2-5 unevenly dark yellowish brown, corresponding sterna slightly paler. Tergal hairs short, each arising from a small tubercle; hairless, glossy band across most of anterior one-third of terga 3-5. Segments 6-9 darker yellowish brown than more anterior segments, nearly reddish brown. Segments 7 and 8 each slightly longer than 6. Notal organ inconspicuous: a broad, scarcely projecting lobe on posterior margin of tergum 3, with downcurved pale setae, and a small median protuberance with sharp, densely sclerotized tip on tergum 4. Ninth sternum narrowed to slender, median prolongation extending to level of ventral fusion of basistyles (Fig. 3), there dividing into two short, slender branches (hypovalves); hairs short, pale, almost perpendicular to sides of sternal prolongation and hypovalves. Tergum 9 elongate, extending well past ends of basistyles, narrowed to subacute apex; margins thickened on underside and bearing numerous (about 20 on each side) long, thick but pale setae directed mesad, their distal ends crossing in preserved specimens. Basistyles elongate, joined ventrally for slightly more than half their length. Dististyles slender, slightly concave on outer surface in proximal half, abruptly curved in distal one-fourth to acute apex. Inner basal lobe (tooth, of Carpenter, 1931) broadly rounded on posteroventral surface, shallowly concave on concealed anterior surface, with blackened, subacute tooth on dorsal margin.

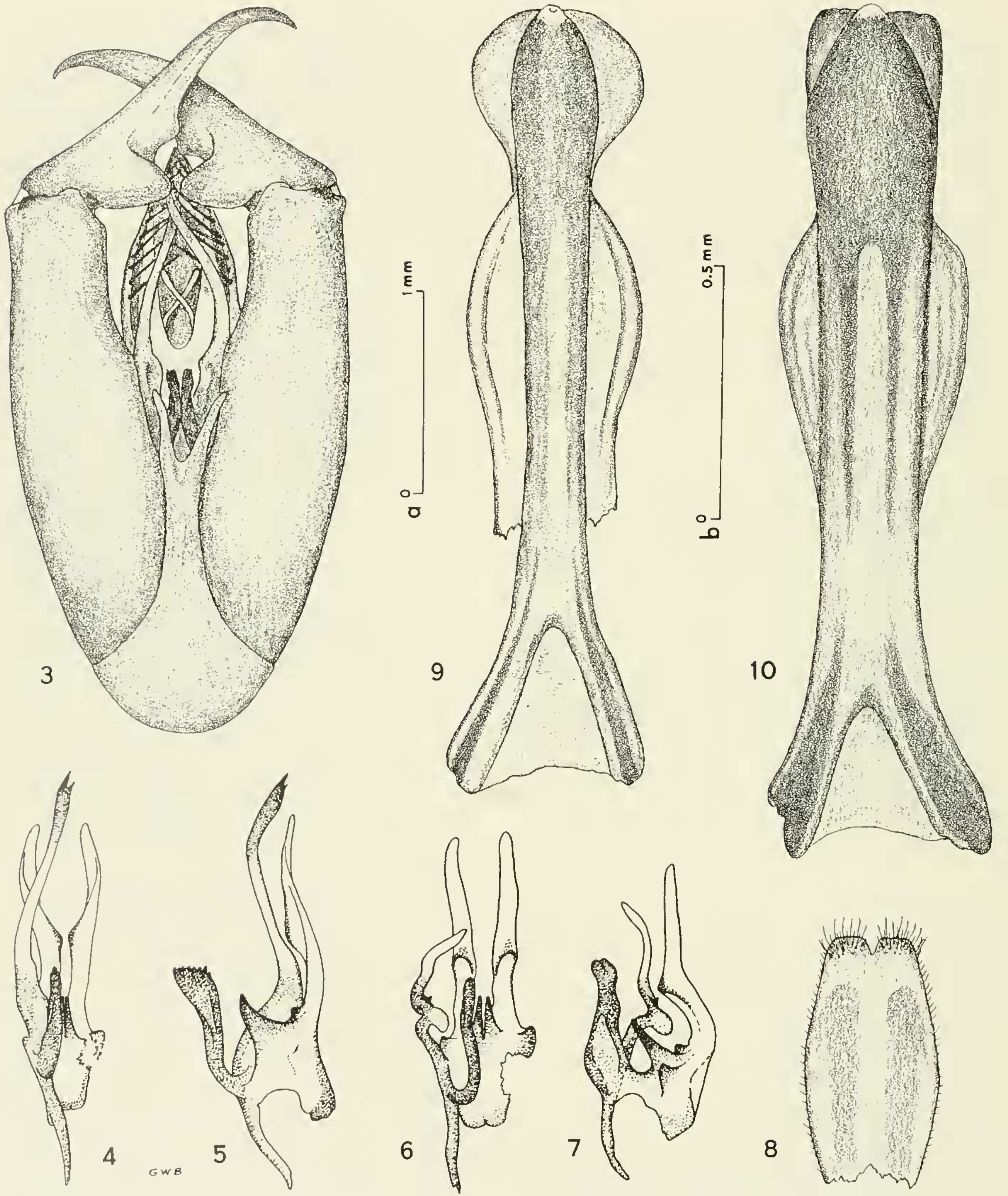
Aedeagus (Figs. 4, 5) with ventral and dorsal valves darkly sclerotized, ventral valves compressed, roughly triangular in lateral aspect; dorsal valves forming a low, median tubercle. Ventral parameres comprising an elongate, smooth dorsal branch with apical and subapical spines and a more densely sclerotized, compressed ventral branch, expanded apically with unevenly serrate margin (seen in lateral aspect) (cf. two-branched hypomere described by Ferris and Rees, 1939, Fig. 51). Dorsal parameres mostly pale, flattened apically, twisted and with darkened mesal edges near mid-length. No aedeagal hamulus. Segments 10 and 11 short, cerci relatively long, slender, crossed in preserved specimens, all concealed beneath ninth tergum but partially visible from below.

Abdomen of female: Terga and sterna dark yellowish brown; cerci black, truncate at apex. Subgenital plate (Fig. 8) with two broad, nearly truncate posterior lobes. Genital plate long, narrow, thick except for small, moderately sclerotized lateral expansions; posterior apex of apical plate blunt or nearly transverse (Figs. 9, 10). Axial portion (mainly spermathecal duct) as wide as dorsal plate posteriorly, with short, thick anterior apodemes connected by thin but hard, sclerotized sheet. Ventral (basal) genital plate apparently absent. Variation in the shape of the genital plate is surprising, especially the rounded to angular sides of the posterior expansions.

Body length, male, about 18.3 to 18.4 mm. (holotype 18.3 mm.). Length of fore wing 13.5 to 13.9 mm. (holotype 13.5 mm.).

Holotype male, Gainesville, Alachua Co., Florida, 10 November 1970, L. A. Hetrick; also labelled "Hort. Unit #2?" and "hammock." Allotype female, and one male paratype, Gold Head Branch State Park, Clay Co., Florida, 20 Nov. 1982, Scott W. Gross. Additional paratypes: male, Orange Park (northern Clay Co.), Florida, 25 Dec. 1936, K. Wheeler No. 8053; female, Alachua Co., Florida, on saw palmetto, 8 Nov. 1974, D. Richman. The holotype is in the Florida State Collection of Arthropods, Gainesville, the allotype is in the USNM, and paratypes are in the SEM and USNM.

Panorpa floridana belongs to what Esben-Petersen (1921) called the *rufa*-group (=*lugubris* group of Carpenter, 1931). It more nearly resembles *P. rufa* than the other included U.S. species, *nuptialis* and *lugubris*. For a time, I considered the few available specimens of this species to be atypical individuals of *P. rufa* because of the striking superficial similarity of the male genital bulb in the two forms and in spite of the dissimilarity in wing coloration. Although there is great variation in wing pattern of *rufa*, it typically has a wide, branched pterostigmal band, often joined posteriorly to the apical band, a large marginal spot, a complete,



Figs. 3-5, 8-10. *Panorpa floridana*, n. sp. **3**, genital bulb of male holotype, ventral aspect. **4**, aedeagal complex, ventral aspect, right ventral paramere removed. **5**, same, right lateral aspect. **8**, subgenital plate, female allotype, ventral aspect. **9**, genital plate, allotype, ventral aspect. **10**, genital plate, female paratype. **Figs. 6, 7.** *Panorpa rufa* Grav. **6**, aedeagal complex, ventral aspect, right ventral paramere removed. **7**, same, right lateral aspect. Scale a, figs. 3-8; scale b, figs. 9-10.

broad basal band continuous with a darkened costal margin connecting the basal band and anterior basal spot. In *rufa*, the background color of the wing is dull, pale yellowish brown, nearly opaque, while in *floridana* it is a translucent brighter yellowish brown. In *floridana* the bands and spots are less extensive than in *rufa* and darker brown. While the genital bulb in *floridana* resembles that of *rufa*, the aedeagus is different in several details, such as the shapes of the branches of the ventral parameres, the dorsal parameres, and the ventral valves. Comparison of figures 4 and 5 (*floridana*) with 6 and 7 (*rufa*, drawn to the same scale and similarly positioned) will make these differences evident. The two-branched ventral parameres of *rufa* are more like those of *P. nuptialis* than those of *floridana* (cf. Ferris and Rees, 1939, Fig. 51, which however depicts the ventral parameres, or hypomeres, of *nuptialis* in an unnatural position, the lower branches in life being close together).

Almost nothing is known of the habitat of this species. The holotype's locality-date information led me to seek additional specimens in 1977 at the Horticultural Unit of the Florida Department of Agriculture. This is at the eastern edge of San Felasco Hammock, northern outskirts of Gainesville. "Hammock" implies a somewhat elevated area surrounded by lower, wetter terrain and characterized by mixed hardwoods. A variety of oaks, red gum, hickory and some pines were noted at the site. The species takes it name from its known geographic range.

Panorpa virginica Banks

This is primarily a species of the middle Atlantic states. I have seen specimens from Virginia, North Carolina, easternmost Tennessee, northeastern Georgia and northwestern South Carolina. Carpenter (1931) recorded it also from northern Georgia, New Jersey and Connecticut. I have not seen the specimen he recorded from Arkansas but feel confident it belongs to the species described here as *P. choctaw*. Similarly, specimens he reported from Michigan and that I reported from Ohio (Byers, 1962a) are *P. hungerfordi* (Byers, 1973).

P. virginica is a late-summer and autumnal species. The holotype, from northern Virginia (Glencarlyn, Arlington Co.), was collected on 10 October. I found a few individuals in Laurens and Chester counties, South Carolina, on 5 Oct. and 16 males, 24 females in Richmond and Johnston counties, North Carolina on 6 and 7 Oct. 1977. Specimens in other collections are from Hoke, Jackson, Johnston, Macon and Wake counties, North Carolina, 12 Sept. to 7 Oct., and Fairfax, Montgomery, Nansemond and Norfolk counties in Virginia, in September. Recently, Wes Bicha has added records from Anderson, Spartanburg, Union and York counties in South Carolina and Banks, Hall and Stephens counties in Georgia, in early to mid-September. There must be a small spring generation in some years; Carpenter's (1931) Georgia record was for DeKalb Co., 2 June, and I have seen a male from Sevier Co., Tennessee, 29 May.

Five species make up what I call the *virginica* group; they are *P. virginica* Banks, *P. neglecta* Carpenter, *P. hungerfordi* Byers and two new species described here — *P. choctaw* and *P. oconee*. *P. hungerfordi* is not a southeastern species and is not considered further, here. (However, the geographical relationship of *hungerfordi* and *neglecta* needs to be examined.) Ranges of the other four, but only in part for *virginica*, are shown on Map 3.

Panorpa neglecta Carpenter

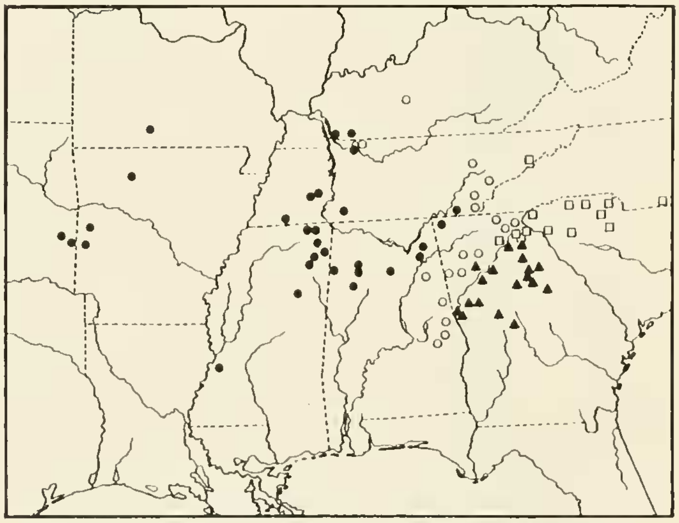
Since it was described, in 1931, this species has been known only from the male holotype, collected at Auburn, Alabama, 19 September 1927, and two specimens from northern Georgia (Carpenter, 1939). With the help of Dr. Kirby Hays, then chairman of the Department of Entomology, Auburn University, I found a suitable habitat near the southwestern edge of the Auburn campus and collected more than 60 specimens, with about equal numbers of males and females.

The habitat was woods-field ecotone of brambles, honeysuckle, greenbriar, and poison ivy at the north edge of a woods, with the brush about one to two feet high. The woods consisted of mostly pine, with some oaks and red gum, small understory trees of dogwood, sassafras, mulberry, etc. Goldenrod was common in the field and ecotone, sparse in the woods (GWB field cat., Alabama, Lee Co. no. 1, 30 September 1977).

Several of the scorpion-flies were engorged with a purplish fluid of which they regurgitated droplets when captured, spotting the net. This fluid's color matched exactly that of the juice of overripe poke berries (*Phytolacca decandra*) that were abundant at the site. Since I could find no living or dead insects other than the scorpion-flies containing this pigment, it is likely that the Panorpas had been feeding directly on the poke berries.

I have not seen the two specimens from Georgia reported by Carpenter in 1939: a male from Blairsville (Union Co.) and a female from Dallas (Paulding Co.). These localities are included on Map 3 since they are consistent with the distribution of *P. neglecta* as otherwise indicated (open circles); however, in my opinion, the "allotype" female was misidentified. The genital plates of the female of *neglecta* are, as anticipated, similar to those of other species in the *virginica* species group, but conspicuously larger (compare Figs. 14, 15, 16). Carpenter's figure 1A (1939: 166) suggests something near *Panorpa helena* (=*venosa* in his 1931 key) or in the *rufescens* species group.

Males from northern Georgia, Tennessee and Kentucky assigned to this species (Map 3) differ from those in eastern Alabama in some details. The ventral, basal rim of the cup of the dististyle is less produced and angular, and the ventral parameres are not as broad at their bases, are slightly longer and have more and larger barbs. In these characters they somewhat resemble males of *P.*



Map 3. Geographical distribution of the *Panorpa virginica* group in southeastern United States. Solid circles - *P. choctaw*; open circles - *P. neglecta*; triangles - *P. oconee*; squares - *P. virginica* (only part of range indicated). Symbols represent one or more collections in a county.

hungerfordi, a northern species from Michigan, Wisconsin, Indiana and Ohio. The geographical ranges as well as the ranges of structural variation in these two nominal species need to be explored further.

Panorpa oconee new species

Description based on 37 males, 28 females pinned, 3 males, 2 females in alcohol.

Head: Dorsum, frons and rostrum including mouthparts dark amber brown; dark brown to blackish spot around ocelli. Scape and pedicel dark yellowish brown, flagellum dark brown to black; 40-43 flagellomeres.

Thorax: Dorsum without distinct markings; pleural surfaces, coxae and mera unevenly yellowish brown (darker in dried, pinned specimens) with fine, silvery pubescence on mesothorax and metathorax, most evident in dorsolateral aspect; scattered pale hairs most dense on anterior surfaces of coxae. Legs dark yellowish brown, tarsi only slightly darker.

Wings strongly tinged with yellow to yellowish brown, with dark brown markings. Apical band complete, broadly concave on proximal side, enclosing small pale spot near end of M or in cell R_{2a} in a few individuals (band complete only to end of M_1 in one male). Pterostigmal band complete, not branched, but with spot near end of M_3. Marginal spot extending from C to R_{2+3} or R_{4+5}. Basal band constricted or broken near mid-length. Basal spot usually from M to Cu_2. Small spot at end of A_2; first humeral spot present but sometimes faint (as in holotype).

Abdomen of male: All terga and sterna unevenly yellowish brown; tergal horn on sixth segment well developed; notal organ consisting of broadly rounded protuberance with downcurved, stiff black hairs on posterior edge of tergum 3 and a median peg-like prominence on tergum 4 covered with black setae curved cephalad. Hypovalves (Fig. 13) extending slightly beyond ends of basistyles, with scattered marginal hairs 3-4 times as long as width of hypovalve, on apical half, and evenly distributed shorter hairs. Tergum 9 (Fig. 12) with U-shaped emargination between two finger-like lobes. Dististyles thick in basal half, narrowing and curving evenly to acute apex. Inner basal cup formed by wide ventral (posterior) flange bearing two prominent, broad, blade-like points, margin between them uneven, darkly sclerotized, and single, broad-based dorsal point (as in Fig. 19). Ventral parameres elongate, reaching apices of dististyles, slightly bowed with tips diverging or less often nearly straight; barbs chiefly on dorsal surfaces of apical two-thirds or more, ventral surfaces smooth, glossy reddish brown; tips acuminate. Dorsal parameres dark brown to black at base, grading through brown to pale yellowish at slightly sclerotized apex, with thin-walled dorsal appendage hanging down toward base of aedeagus. Ventral valves pale, almost membranous, with pale edges diverging from mid-line near base and merging apically with dorsal parameres; dorsal valves apparently fused with bases of dorsal parameres. Aedeagal hamulus flattened, upturned, broadly rounded to nearly truncate at apex, with shallow, median apical notch. Segment 11 recessed within segment 10; long, slender cerci projecting laterad from posterior end of sclerotized, capsule-like segment 10.

Abdomen of female: Terga and sterna yellowish brown in life, sterna slightly paler. In dried specimens, sclerites of segments 1-6 unevenly dark yellowish brown, those of segments 7-11 darker brown; all sclerites pale yellowish brown in specimens preserved in alcohol. Cerci dark brown to black. Subgenital plate pointed at apex, constricted at base by expanded laterotergites. Laterotergites as in *P. choctaw*. Genital plates (Fig. 16) elongate, widest posteriorly, axial portion attaining posterior margin or nearly so, slightly thickened and slightly arched dorsad above basal plate; apodemes about one-third of total length of entire sclerotized structure.

Body length, male, about 10 to 13 mm. (holotype 10.5 mm.); female about 9 to 14 mm. (allotype 11.0 mm). Length of fore wing, male, 12.2 to 13.0 mm. (holotype 12.3 mm.); female, 12.0 to 13.8 mm. (allotype 13.4 mm.).

Holotype male, 2 miles NE of West Point, Troup Co., Georgia, 1 Oct. 1977, George W. Byers. Allotype, 2 miles N of Watkinsville, Oconee Co., Georgia, 3 Oct. 1977, G. W. Byers and H. D. Pratt. Paratypes: GEORGIA: 3m, 3f, same data as holotype; 4m, 6f, same data as allotype; Banks Co., 1 mi. W of Homer, 16 Sept. 1990, WB (1m, 1f); Butts Co., 27 Sept. 1992, WB (1f); Cherokee Co., Woodstock, 5 Nov. 1967, M. Davis (1f); Clarke Co., Athens, North Oconee River, 2 Oct. 1977, GWB (2m, 1f); Athens, 15 Sept. 1980, WB (3m); DeKalb Co., Stone Mt., 1 Oct. 1961, L. Washington (1m); Greene Co., Oconee National Forest, 8 mi. W of Greensboro, 1 Oct. 1977, GWB (4m, 4f); same, but 3 Oct. 1977 (8m, 8f); Gwinnett Co., Loganville, 14 Sept. 1980, WB (8m, 8f); Hall Co., Gillsville, 16 Sept. 1990 WB (2m, 1f); Harris Co., near Pine Mountain, 25 Sept. 1988, WB (1m); Jackson Co., 1 mi. E of Commerce, 16 Sept. 1990 WB (2m, 1f); Lamar Co., 9 Oct. 1982, R. Morris (1m); Meriwether Co., 27 Sept. 1992, WB (1m); Monroe Co., U.S. Hwy 23, 2.7 mi. N of Ga. Hwy. 83, 28 Sept. 1974, T. E. Moore (1m); Monroe Co., 27 Sept. 1992, WB (1m); Morgan Co., 11 mi. W of Madison, 1 Oct. 1977, GWB (1m, 2f); Oconee Co., Oconee Nat. Forest, 15 Sept. 1980, WB (4m, 7f); Watkinsville vic., 16 Sept. and 3 Oct. 1977, C. K. Starr (1m, 1f); Oglethorpe Co., 3 mi. SE of Lexington, 4 Oct. 1977, GWB (2m, 2f); Oglethorpe Co., 1 mi. S of Little Creek, 15 Sept. 1990, WB (2m); Pike Co., 27 Sept. 1992, WB (1m); Taliaferro Co., 2 mi. S of Lyneville, 15 Sept. 1990, WB (1m).

Holotype, allotype, and most paratypes are in the SEM. Other paratypes are in the UMMZ, the Univ. of Georgia and the collection of Wes Bicha, Oliver Springs, Tennessee; paratypes will be deposited in the USNM and the MCZ.

Panorpa oconee is clearly a close relative of *P. choctaw*. Although the two have many characteristics in common, they also show consistent differences, particularly in the genital bulb of the males. Comparison of figures 13 and 17 shows that the ventral parameres of *oconee* are much shorter and more slender than those of *choctaw*, and the projections defining the mesal cup of the dististyle in ventral aspect are shorter and closer together than their counterparts in *choctaw*. The aedeagal hamulus in *oconee* has almost parallel sides enclosing a thin, lightly sclerotized area near the blunt apical margin. Females of *oconee* and *choctaw* are very similar. Those that have been dissected (that is, not identified by association with males) show the axial portion of the genital plates longer in *oconee*, the anterior apodemes longer and the opening of the spermathecal duct nearer to the posteromedian margin (cf. Fig. 16 and Fig. 22).

The small range of *Panorpa oconee* is generally east of those of *P. neglecta* and the more widely distributed *P. choctaw* (Map 3) and southwest of the range of another near relative, *P. virginica*. These four structurally similar species seem to displace each other geographically much as in the case of *Panorpa subfurcata* Westwood, *P. subulifera* Byers, *P. longicornis* Carpenter and *P. carolinensis* Banks.

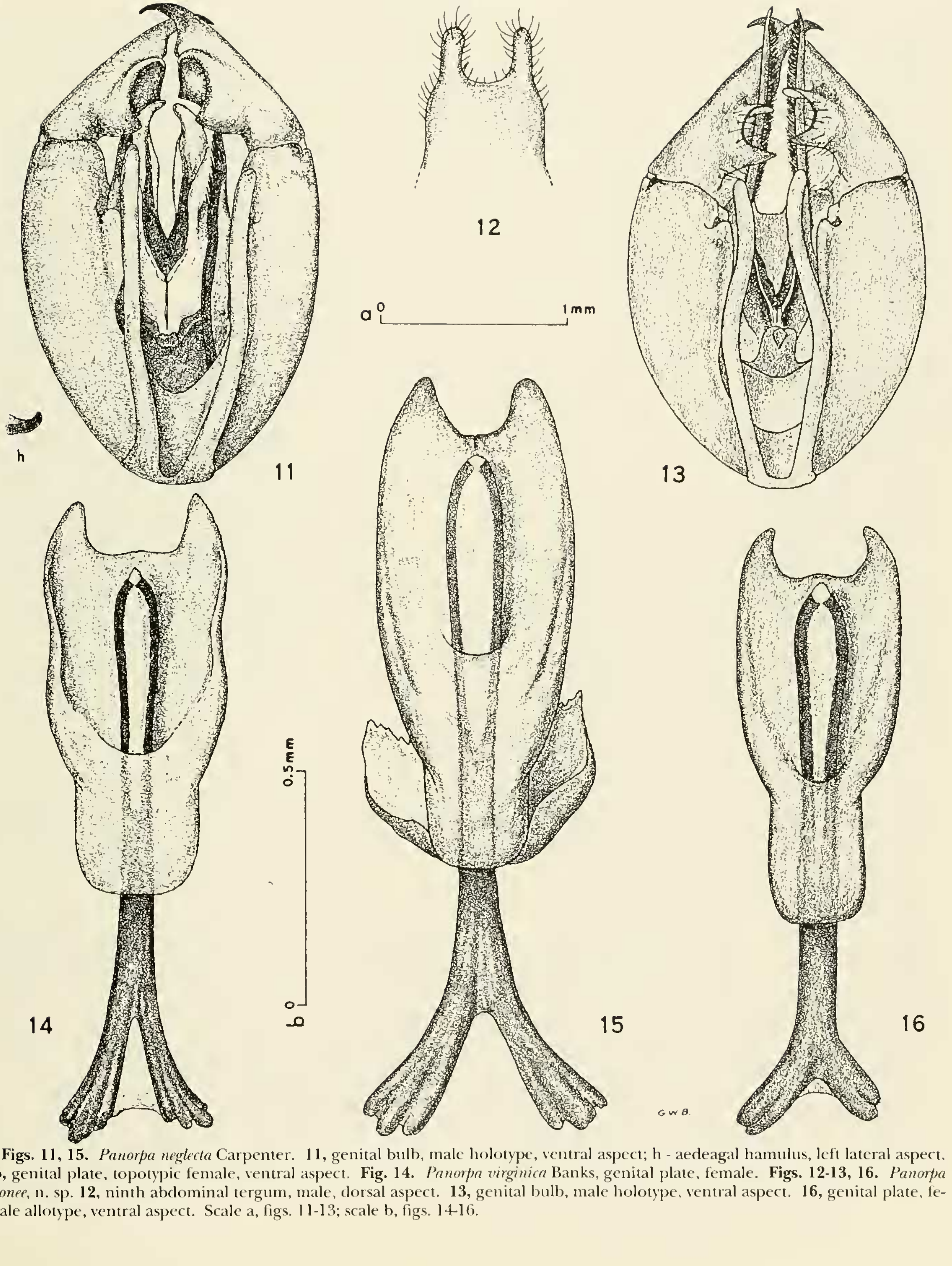
As at the type locality, *Panorpa oconee* has most often been found in association with the tangled growth of honeysuckle, brambles, poison ivy and greenbriars so characteristic of woods borders in the region. The more general environment at the Troup County site was pine woods with saplings of red gum, tulip tree, oaks and juniper. Much of the ground was covered with fallen pine needles.

Panorpa oconee takes its name from some geographical features within its range: the Oconee River, Oconee National Forest and Oconee County, Georgia. The word "Oconee" is of uncertain origin. Possibly derived from a Cherokee word meaning river, it was applied to two divisions of the Creek tribe, according to information supplied by reference librarian Jay Evatt, University of Georgia.

Panorpa choctaw new species

Description based on 107 males, 59 females pinned, 8 males, 9 females preserved in alcohol.

Head: Dorsum of head, frons and rostrum amber-brown, mouth-



Figs. 11, 15. *Panorpa neglecta* Carpenter. **11,** genital bulb, male holotype, ventral aspect; h - aedeagal hamulus, left lateral aspect. **15,** genital plate, topotypic female, ventral aspect. **Fig. 14.** *Panorpa virginica* Banks, genital plate, female. **Figs. 12-13, 16.** *Panorpa oconee*, n. sp. **12,** ninth abdominal tergum, male, dorsal aspect. **13,** genital bulb, male holotype, ventral aspect. **16,** genital plate, female allotype, ventral aspect. Scale a, figs. 11-13; scale b, figs. 14-16.

parts darker brown; irregular dark brown to black pigmentation around ocelli in most individuals. Antennal scape, pedicel and most of first flagellomere amber-brown, rest of flagellum brownish black; 39-41 flagellomeres.

Thorax: Pronotum, mesonotum and metanotum unevenly amber-brown throughout (i.e., no distinct markings). Pleural surfaces, coxae and mera unevenly dark yellowish brown with minute silvery pubescence visible in dorsolateral aspect, and with scattered yellowish hairs most dense on anterior surfaces of coxae. Femora, tibiae and tarsi generally sordid amber-brown, apical tarsomeres dark brown.

Wings strongly tinged with yellow to pale yellowish brown, banded and spotted with dark brown. Apical band complete, its proximal edge usually concave between R_2 and M_1, rarely enclosing small yellowish spots near wing margin; four cross-veins within apical band pale whitish. Pterostigmal band complete, unbranched, extending from proximal half of stigma to apex of Cu_1; outer branch represented by spot of variable extent near tip of M_3. Marginal spot slightly developed, usually extending from C to R_{2+3}, with small spot behind R_{4+5}, less commonly complete from C to behind R_{4+5} or fragmented into small spots. Basal band narrowly constricted or interrupted near mid-length. Basal spot usually extending from M to Cu_2, slightly larger or smaller in some individuals. Small, diffuse spot in angle between tip of A_2 and wing margin. First humeral spot present, second absent (both present in one wing of a female from Oklahoma).

Abdomen of male: Terga and sterna 1-6 sordid yellowish brown, segments 7-9 yellowish brown; conspicuous horn on segment 6; notal organ of tergum 3 only slightly developed, with numerous downwardly curved black hairs. Hypovalves of sternum 9 as long as basistyles or slightly longer, slender, with scattered hairs 3-5 times as long as width of hypovalve on apical half, shorter hairs evenly distributed throughout. Ninth tergum with two short, thick apical lobes (Fig. 18). Dististyles greatly thickened in basal half, with curved, strongly sclerotized, sharply pointed apex. Inner basal cup bordered ventrally by wide flange with irregular, darkened, sclerotized margin bearing large, acutely pointed, blade-like ventral projection (Fig. 17) and more distal, broadly triangular projection (appearing narrow in figure because of ventral aspect). Dorsal side of cup a trapezoidal to broadly triangular flange (Fig. 19). Ventral parameres extending far beyond tips of dististyles as dark reddish brown, smooth blades with acuminate tip and densely set barbs on apical two-thirds or more of dorsal surface. Dorsal parameres black basally, pale yellowish brown apically, with thin dorsal appendage (not visible in ventral aspect). Ventral valves light brown with narrow, pale ridges along ventral margins, ridges in contact at mid-line basally, then diverging and joining apically with dorsal parameres; dorsal valves minute, fused with bases of dorsal parameres; dorsal valves minute, fused with bases of dorsal parameres. Aedeagal hamulus thick, broad, smooth, upturned, with convex lower surface and apex rounded or slightly notched medially. Segments 10 and 11 concealed beneath ninth tergum in dorsal aspect, but elongate one-segmented cerci project laterally, lying against dorsal surfaces of dististyles.

Abdomen of female: Terga yellowish brown in life, somewhat paler in specimens in alcohol, darker brown in dried specimens; corresponding sterna paler than terga; cerci dark brown to black. Subgenital plate approximately elliptical, pointed at apex, constricted by laterotergites at base (Fig. 21). Laterotergites complex, broadest basally (Fig. 20), tapering posteriorly, convex below in life but unevenly concave ventrolaterally when dried; color dark yellowish brown to brown, surface glossy; double fold of thin but sclerotized, paler cuticle at each side immediately below ninth tergum. Genital plates (Fig. 22) elongate, widest posteriorly, with short, wide posterior lobes; axial portion not reaching posterior margin, somewhat widened and slightly arched dorsad above basal plate; apodemes diverging near anterior edge of basal plate.

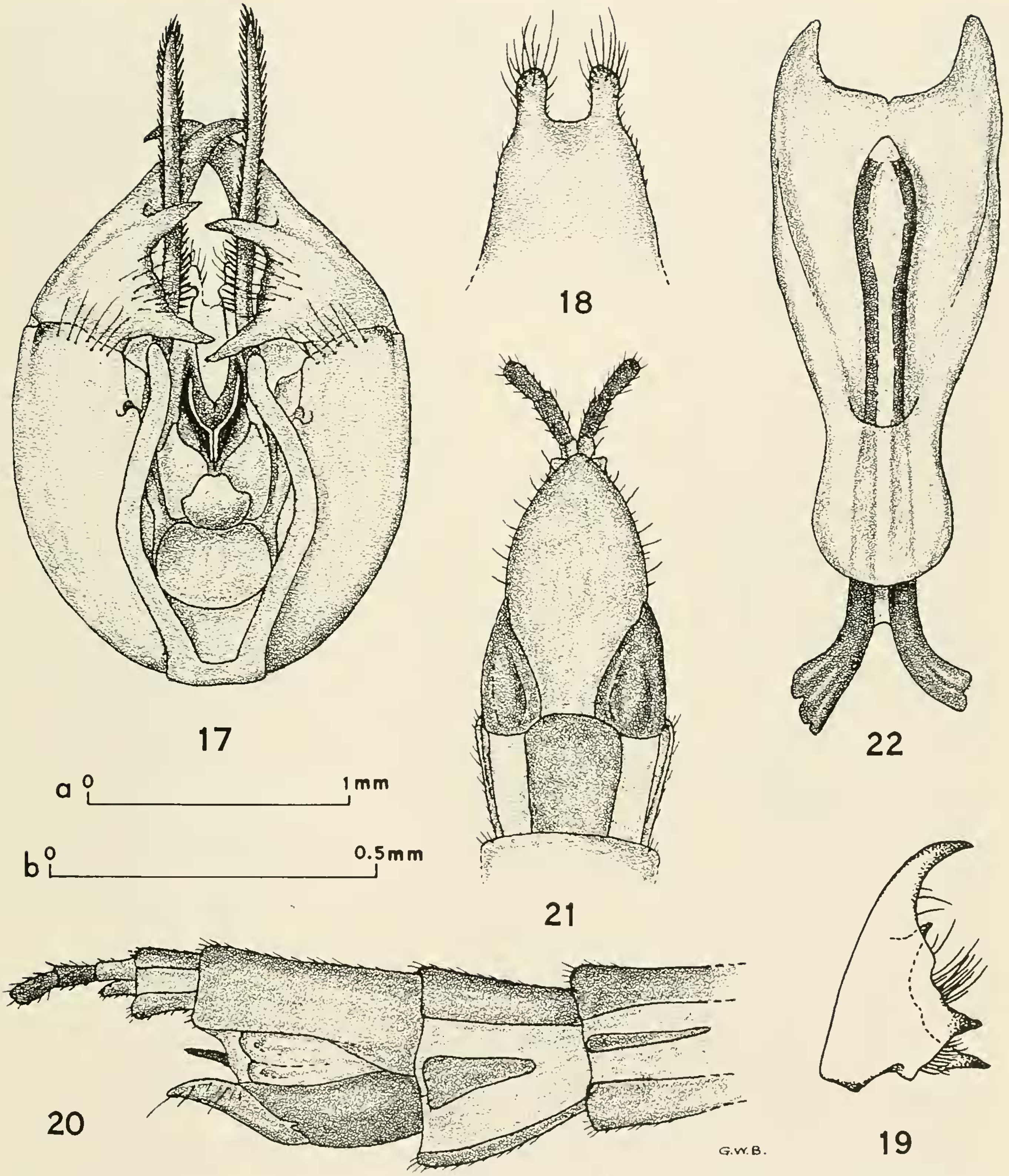
Body length, male, about 10 to 15 mm. (holotype 10.6 mm.); female, also about 10 to 15 mm. (allotype 11.7 mm.). Length of fore wing, male, 10.5 to 14.5 mm. (holotype 11.2 mm.); female, 12.0 to 13.9 mm. (allotype 12.4 mm.). On average, both males and females from the western part of the range (Arkansas and Oklahoma) are slightly larger than those from eastern states.

Holotype, male, Tombigbee State Park, 6 mi. SE of Tupelo, Lee Co., Mississippi, 26 Sept. 1977, George W. Byers. Allotype, 20 male and 18 female paratypes same data as holotype. Additional paratypes: ALABAMA: Blount Co., 13 Sept. 1992, WB (1m); DeKalb Co., Collinsville, 29 Sept. 1988, WB (1m, 1f); Fyffe, 1 Oct. 1988, WB (1m); Etowah Co., 11 mi. W of Gadsden, 13 Sept. 1980, WB (2m, 2f); Fayette Co., 3 mi. W of Berry, 27 Sept. 1977, GWB (1m, 1f); Lawrence Co., Bankhead, 28 Sept. 1975, L. Glenboski (1f); Marion Co., 11 mi. E of Hamilton, 26 Sept. 1977, GWB (2f); Marion Co., 13 Sept. 1992, WB (1m); Winston Co., Corinth Recreation Area, Bankhead National Forest, 27 Sept. 1977, GWB (7m, 3f); Winston Co., Bankhead Nat. Forest, 12 Sept. 1980, WB (6m). ARKANSAS: Newton Co., Dogpatch, 5 Sept. 1971, A. S. Menke (1f); Polk Co., U. S. Hwy. 270 near Scott Co. line, 1160 ft., 27 Sept. 1979, GWB (7m, 8f); Scott Co., Mill Creek at Y City, 740 ft., 27 Sept. 1979, GWB (1m); Ouachita National Forest, T1N, R30W, Sec. 33, 27 Sept. 1979, 1020 ft., GWB (1m, 4f). GEORGIA: Walker Co., LaFayette, 1 Oct. 1988, WB (1m). KENTUCKY: Trigg Co., Land Between the Lakes, 2 Oct. 1982, WB (3m, 1f). MISSISSIPPI: Benton Co., 14 mi. S of Ashland, 7 Sept. 1986, WB (7m); 4 mi. SW of Troy, 21 Sept. 1974, R. Patterson (1m); Chickasaw Co., Davis Lake, 11 mi. WNW of Okolona, 25 Sept. 1977, GWB (3m, 4f); Claiborne Co., Rocky Springs, Natchez Trace Parkway, 14 mi. NE of Port Gibson, 23 Sept. 1977, GWB (3m); milepost 242 Natchez Trace Parkway, 6 Sept. 1986, WB (1m); Itawamba Co., 13 Sept. 1992, WB (1m); Lee Co., Tombigbee State Park, 14 Sept. 1974, R. Patterson (1f); milepost 276 Natchez Trace Parkway, 6 Sept. 1986, WB (3m); Prentiss Co., Boonville, 11 Oct. 1984, S. MacDonald (1f); Tippah Co., 1 mi. S of Falkner, 7 Sept. 1986, WB (2m); Webster Co., 7 mi. W of Walthall, 18 Oct. 1987 (1f), 19 Oct. 1990, T. L. Schiefer (1m). MISSOURI: Douglas Co., 5 Sept. 1981, WB (1m, 1f). OKLAHOMA: Latimer Co., 7 mi. E of Wilburton, 625 ft., 26 Sept. 1979, GWB (1m, 1f); 5 mi. W of Red Oak, 25 Sept. 1977, K. Stephan (1m); locality?, Sept. 1986 (1m, 1f) Sept. 1988 (2m), Sept. 1989 (2m, 3f), Oct. 1988 (6m, 4f), all collected by K. Stephan; Le Flore Co., U. S. Hwy. 270, 3.5 mi. W of Arkansas state line, 27 Sept. 1979, GWB (15m, 11f). TENNESSEE: Bradley Co., 1 Oct. 1988, WB (2m); Chester Co., Chickasaw State Park, 7 Sept. 1986, WB (3m); Hardeman Co., 1 mi. S of Bolivar, 7 Sept. 1986, WB (2m); Henderson Co., 7 Sept. 1986, WB (4m); Wayne Co., mile 347 Natchez Trace Parkway, 5 Sept. 1986, WB (5m).

Holotype, allotype and most paratypes are in the collection of the SEM. Other paratypes are in the collections of Wes Bicha, Oliver Springs, Tennessee; Mississippi State University; Bryant Mather, Clinton, Mississippi; and the Florida State Collection of Arthropods, Gainesville; and paratypes will be placed in the USNM, the MCZ and the the UMMZ.

Panorpa choctaw belongs to a group of species that in many ways resemble *Panorpa virginica* Banks. Males in this *virginica*-group have the basal cup of the dististyle bordered ventrally by a wide flange with a more or less jagged or irregularly toothed margin. They also have long, slender hypovalves, elongate, unbranched ventral parameres and a conspicuous but blunt or rounded aedeagal hamulus. Females are characterized by well developed, sclerotized laterotergites between the ninth abdominal tergum and the subgenital plate and by elongate genital plates the axial portion of which does not reach the posterior margin. The wings in all these species are similarly strongly tinged with yellow to pale amber and marked with dark brown.

Males of *P. choctaw* are readily distinguished from those of other species by the large, blade-like projections from the margin of the basal cup of the dististyle and by the conspicuously elongated, nearly straight ventral parameres that project well beyond the ends of the dististyles. (In males from Arkansas and Oklahoma, the ventral parameres are somewhat shorter than in males from east of the Mis-



Figs. 17-22. *Panorpa choctaw*, n. sp. **17,** genital bulb, male holotype, ventral aspect. **18,** ninth abdominal tergum, male paratype, dorsal aspect. **19,** right dististyle, male paratype, dorsal aspect. **20,** terminal abdominal segments, female allotype, right lateral aspect. **21,** same, ventral aspect. **22,** genital plate, female allotype, ventral aspect. Scale a, figs. 17-21; scale b, fig. 22.

sissippi River, and the distal margin of the cup of the dististyle is less conspicuously projecting.) Females may be recognized by the greatly developed and complex laterotergites of the ninth abdominal segment (but see *P. oconee*).

Adults of this species occur on shaded, low vegetation primarily at the edges of woods. At the type locality, they were on the regionally typical ecotone vegetation of brambles, greenbriars, honeysuckle and poison ivy at the edge of a woods of red oak, white oak, sweet gum, some pine, etc., with a sparse understory of dogwood, sassafras and other species. The flight period of *P. choctaw*, as far as now known, is from 5 September to 2 October, with a distinct peak in late September.

This species is named for the Choctaw Indians, who at various times inhabited the lower Mississippi region and migrated as far east as Georgia, then were forced to move westward into eastern Oklahoma. Lands occupied by the Choctaws correspond approximately to the range of *Panorpa choctaw*.

Panorpa bichai new species

Description based on 21 males, 2 females in alcohol, 6 males, 1 female pinned (most originally preserved in alcohol).

Head: Dorsum, frons and rostrum light amber-brown, apex of rostrum and mouthparts darker brown; irregular black spot around ocelli. Antennal scape pale yellowish brown, pedicel and basal one or two flagellomeres gray, grading into black on most of flagellum; 37-41 flagellomeres but 37 or 38 in most individuals.

Thorax: Pronotum, mesonotum and metanotum yellowish brown without darker markings. Pleural surfaces and coxae pale yellowish brown, with four small but conspicuous black spots, one at anteroventral and posterodorsal corners of mesepimeron and metepimeron (less conspicuous in dried specimens). Femora pale brown, tibiae and tarsi slightly darker, appearing grayish because of rings of slender black setae.

Wings tinged with yellow, banded with dark brown. Apical band complete or, more often, fragmented into spots or with included pale areas; enclosed cross-veins white. Pterostigmal band diagonal from proximal half of stigma to near end of Cu_1, narrowed near its mid-length and with uneven edges; distal branch represented by small spot near margin between M_3 and M_4. Marginal spot present, variable in size. Basal band constricted near mid-length or divided into two spots. Basal (first basal) spot variable in extent from Rs to Cu_2 or smaller. Humeral spots absent.

Abdomen of male: Terga 2-5 unevenly grayish brown dorsally, yellowish brown at sides; corresponding sterna pale yellowish brown; segments 6-9 darker yellowish brown; conspicuous horn on segment 6; notal organ a low, broad lobe on posterior margin of tergum 3 bearing downwardly curved black hairs and a small, forwardly curved peg on tergum 4. Hypovalves of sternum 9 extending approximately to ends of basistyles (Fig. 23), of uniform width throughout, with yellowish hairs longer than width of hypovalve along mesal edges, shorter hairs along outer edges. Lobes of tergum 9 rounded apically; tergum slightly narrowed before bases of lobes (Fig. 24). Dististyles (Fig. 23) with outer margins shallowly concave near mid-length, apical one-third densely sclerotized, curved inward and sharply pointed. Inner basal cup shallow with darkly sclerotized margins. Thick, black setae (usually 3) on inner, apical protuberance of basistyle (Figs. 23, 25). Ventral parameres long, slender, extending well beyond ends of basistyles, their outer ends often bent dorsad, mesad or both; lateral (outer) edge of each densely sclerotized, smooth, with sparse hairs on apical half; inner edge pale with fringe of flattened, dark reddish brown barbs along almost entire length, terminating in apical spine (Fig. 26). Dorsal parameres black mesally near base, pale apically with membranous dorsal appendage. Ventral and dorsal valves of aedeagus not clearly differentiated. Aedeagal hamulus (Fig. 23) conspicuous, with two elongate, attenuate, flattened tines extending beyond bases of dorsal parameres. Segments 10 and 11 mostly concealed by ninth tergum; apical halves of cerci visible in dorsal aspect.

Abdomen of female: Terga unevenly yellowish brown, sterna slightly paler than terga; cerci black. Subgenital plate widest near base, obtusely pointed at apex, medially membranous at base, with wide apical margin pale, subhyaline (Fig. 27). Genital plates (Figs. 28, 29) with thick anterior apodemes, axial portion not attaining posterior margin of distal plate; apical projections of distal plate slightly curved mesad; thin, sclerotized calyx attached to basal plate, curving loosely around distal plate to connect to sides and roof of genital chamber.

Body length, male, 11.2 to 14.6 mm (holotype, pinned, 11.8 mm); female, 9.4 to 11.2 mm (allotype, pinned, 9.4 mm). Length of fore wing, male, 10.0 to 12.1 mm (holotype 10.6 mm); female, 12.2 to 12.3 mm (allotype 12.3 mm).

Holotype male, Frozen Head State Park, Morgan Co., Tennessee, 5 August 1989, collected by Wes Bicha. Allotype, 13 male and 1 female paratypes, same data as holotype. Additional paratypes: TENNESSEE, Anderson Co., 12 August 1989, WB (8m); Anderson Co., Department of Energy Reservation, 10 Sept. 1990, WB (1m); Fentress Co., 10 Sept. 1990, WB (2m); Hawkins Co., Laurel Run, 1200 ft., 12 mi. W (label says E) of Kingsport, 14 Aug. 1982, H. D. Baggett (1m); Morgan Co., Frozen Head State Park, 12 Sept. 1988, WB (1m). Holotype, allotype and 4 paratypes in the SEM. Paratypes in collections of WB, USNM, and the Florida State Collection of Arthropods, Gainesville.

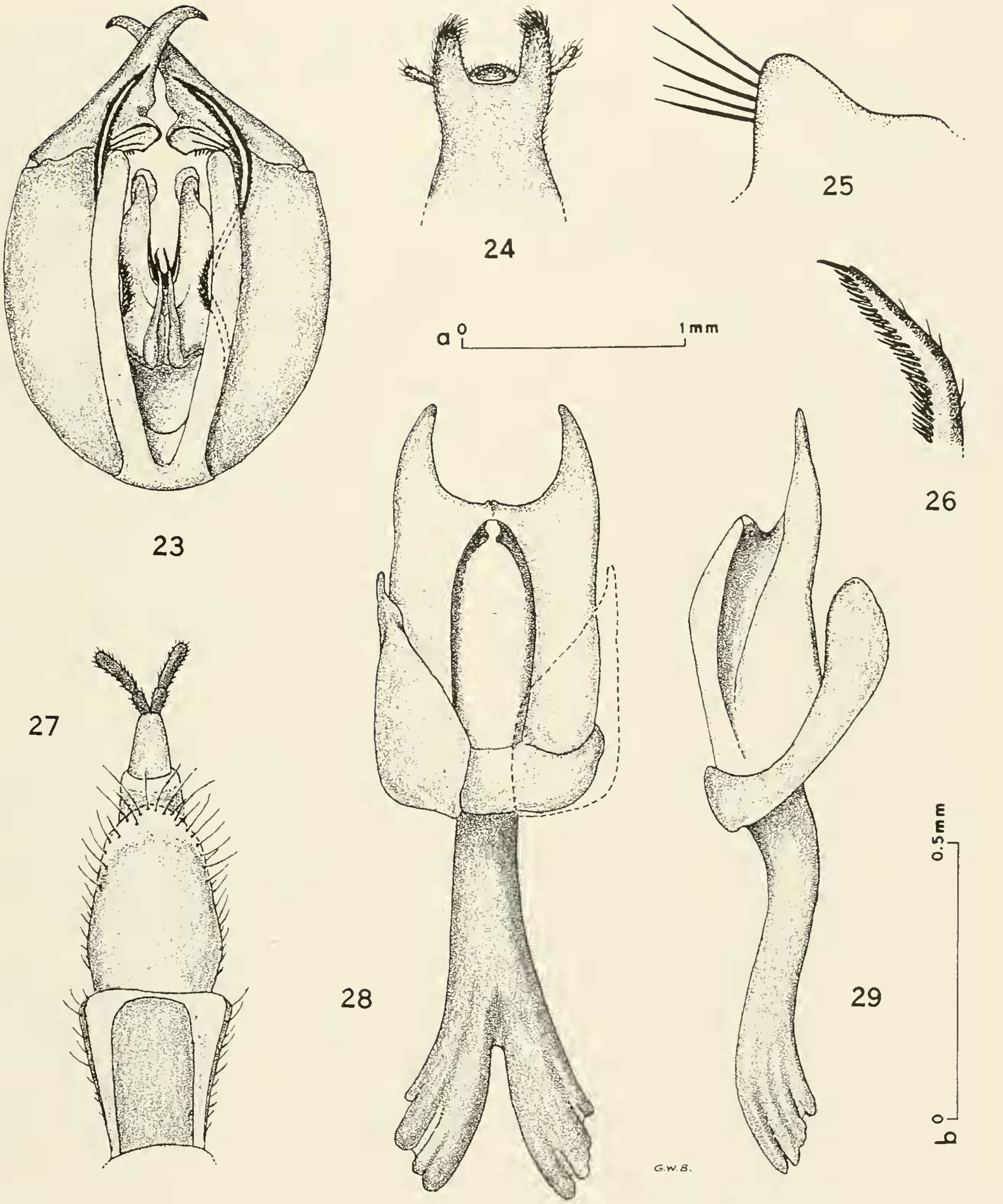
This species is named for Mr. Wesley (Wes) Bicha, engineer and amateur entomologist, who collected nearly all the specimens and who has made the geographic ranges of many nearctic Mecoptera better known, as a result of his extensive travels and enthusiastic collecting.

Panorpa bichai most closely resembles *P. setifera* Webb, and both these species have numerous structural similarities to *P. debilis* Westwood. At the time Webb described *setifera*, both he and I were impressed by its resemblance to *P. helena* Byers in wing pattern and presence of thick, black setae on ventro-mesal prominences on the basistyles of the male. However, I now think that the aedeagal hamulus is a stronger indication of relationship. This structure and the wing pattern of *bichai* and *setifera* agree even more closely with these characters in *debilis* than in *helena*. The apical setae on the basistyles are thickened in *bichai* (Figs. 23, 25) and *setifera*, as in *helena*, but are borne on a prominence as in *debilis*, not as in *helena*.

The most conspicuous difference between males of *P. bichai* and *P. setifera* is in the ventral parameres. These are only slightly curved, and much broader in the basal part (at the level of the aedeagal hamulus) than in the apical half, in *setifera*, and extend only slightly beyond the apex of the aedeagus or the basistyles. In *bichai* they are bowed outward, are more slender throughout and extend far beyond the ends of the basistyles (Fig. 23).

Panorpa bifida Carpenter

Both the geographic and seasonal distributions of *P. bifida* remain sketchy. Described from western Pennsylvania, the species was subsequently found in Champaign and Ross counties, Ohio, and Tyler Co., West Virginia, near the Ohio River. I have collected it from time to time in Giles Co., Virginia (14 June 1975, 2 and 8 July 1975, 23 July 1979, 11 Aug. 1982, 5 July 1986 and 25 July 1992, at elevations from 554m. to 1060 m.), where it has always been uncommon. And Wes Bicha has found it at Lobelville, Perry Co., Tennessee, on 5 Sept. 1986 and 22 Sept. 1991. The last of these records shows that *bifida* can be autumnal in occurrence, although it is primarily a mid-summer species.



Figs. 23-29. *Panorpa bichai,* n. sp. **23,** genital bulb, male paratype (topotypic), ventral aspect; dashed line indicates shape of ventral paramere. **24,** ninth abdominal tergum, dorsal aspect. **25,** ventro-mesal apex of right basistyle, male holotype. **26,** apex of right ventral paramere, holotype. **27,** terminal abdominal segments, female allotype, ventral aspect. **28,** genital plate, female allotype, ventral aspect; dashed line indicates cuticular fold partially enveloping basal and apical plates. **29,** same, right lateral aspect. Scale a, figs. 23-24, 27; scale b, figs. 25-26, 28-29.

Panorpa braueri Carpenter

Three males and five females of this uncommonly collected species were found in a narrow, shaded ravine near the western edge of Bentonville, Benton Co., Arkansas, on 21 Sept. 1977, and one male, two females were collected at the same site on 28 Sept. 1979. The scorpion-flies were on herbaceous plants (mainly mints) beside the dry bed of a small brook, shaded by white oak, sycamore, elm and other deciduous trees. The type series (1m, 3f) was collected in adjacent Washington County, in May; and there are September records from this county. The species is known also from Marion Co., Arkansas, and Carter, Barry, Franklin, Gasconade, Green, Laclede, Newton and Pulaski counties in Missouri, in May-July.

Panorpa isolata Carpenter

Although for some time it has appeared that this species is bivoltine with peaks of emergence in June and August (Byers, 1954), it is also autumnal in the southeastern states. Following are examples: Georgia, Clarke Co., 20 Oct. 1973 (1m); Franklin Co., 11 Nov. 1974 (1f); Gwinnett Co., 1 Nov. (year not recorded) (1f with anterior basal spot and humeral spots fused in left front wing); Alabama, Calhoun Co., 21 Sept. 1966 (1m).

Based on his extensive collecting experience, Wes Bicha considers *P. isolata* to be bivoltine in the Southeast, with peaks of emergence in early May and again in August until mid-September, and with some individuals present until frost.

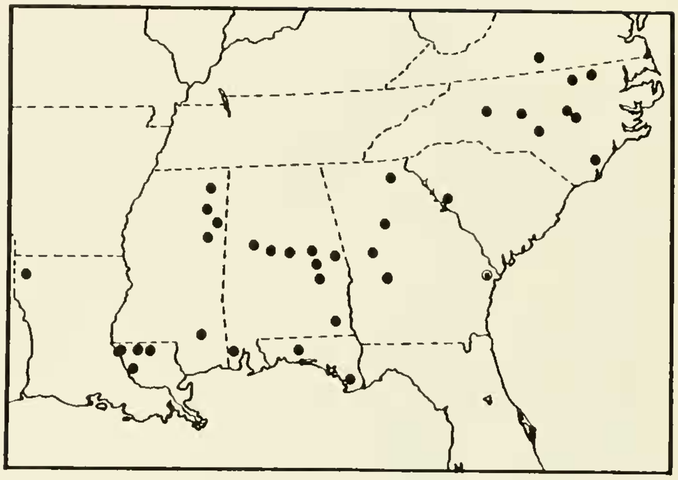
P. isolata has been found in Mississippi (Yalobusha Co., Tishomingo Co., May records only), Alabama, Georgia, eastern Tennessee, western North and South Carolina and the District of Columbia. Carpenter (1935) also recorded it from Waukegan, Illinois; but I think he must have confused it with his *Panorpa dubitans*, the key difference between males of the two being a slight difference in length of hypovalves.

Panorpa americana Swederus

Chiefly a lowland species, *P. americana* has been found from New Jersey and Delaware southwestward across Virginia, the Carolinas, Georgia, northern Florida, Alabama and Mississippi to Louisiana (Map 4). It is clear from this map of collecting localities, however, that our knowledge of the range of *americana* is fragmentary and uneven. The collections I have seen also suggest that *P. americana* is never an abundant species where it has been found. Most of these places are less than 150 m. above sea level, and all but one are below 300 m. (about 1000 ft.). The exception (Carpenter, 1939) is Yonah Mountain, Georgia (in White County), the base of which is near 450 m., the summit 850 m. Inclusive dates for this collection of 4 specimens are 10-20 June, also exceptional, as all other records are for late September to early November.

P. americana is an easily recognized species, its relatively broad wings deeply tinged with yellow, the dark brown apical, pterostigmal and basal bands with fairly even edges, the marginal spot small and the anterior basal spot merged with a single (first?) humeral spot.

Nothing has been published regarding the habitat of *P. americana*. My collections in the fall of 1977 indicate that in much of the southern part of its range this species occurs in woods-field ecotones shared with various other Panorpas. In Oktibbeha Co., Mississippi (near State College, 25 September), *americana* was found on honeysuckle (*Lonicera* sp.) only a little above ground level. In Chickasaw Co., Miss. (near Woodland, 25 Sept.), the habitat was brambles (*Rubus* sp.), honeysuckle, greenbriar and poison ivy. In Elmore Co., Alabama (6 mi. W of Wetumka, 29 Sept.), it was brambles and honeysuckle. And in McCormick Co., South Carolina (Sumter National Forest, near the Savannah River, 4 October), *americana* was again found on honeysuckle, greenbriar, brambles and trumpet vine (*Campsis radicans*). In each of these localities, a variety of habitats was investigated.



Map 4. Geographical distribution of *Panorpa americana*. Solid circles represent one or more autumnal collections in a county (or parish, in Louisiana); circle enclosing a spot represents the holotype of this species from an unknown locality in Georgia at an unknown date prior to 1787.

Panorpa gracilis Carpenter

Only two males comprised the type series of this species (Carpenter, 1931). These were collected at or near Tarboro, North Carolina, in April and May 1924. The species was not found again until 1977. It seemed to me that *gracilis* might also have an autumnal flight period, and being in the Tarboro vicinity on 8 October, I drove there in search of *P. gracilis*. In early afternoon, I stopped at a woods about 2 miles east of Tarboro on U. S. Highway 258. There, on the narrow floodplain of a tributary of the Tar River, I found, in two hours of collecting, a few individuals of *Panorpa virginica* and more than 70 males and females of the elusive *P. gracilis*.

The habitat was shaded by oaks, hickory and, near the small, clear, sand-bottomed stream, sycamore, red gum and bald cypress (with "knees," suggesting prolonged spring flooding). Ground cover was mainly poison ivy and greenbriar. *Panorpa gracilis* was found most often on patches of *Tradescantia* growing together with *Carex*, nettles and greenbriars near the bases of cypress trees (GWB field cat., North Carolina, Edgecombe Co. no. 1).

Later the same day (8 Oct.), I collected two males and six females of *gracilis* 11 miles southeast of Enfield, Halifax Co., North Carolina.

More recently the known range of this species has been considerably extended by the collecting activities of Wes Bicha, as follows: NORTH CAROLINA: Beaufort Co., 7 May (3m, 1f) and 17 Sept. 1980 (3m, 3f); Edgecombe Co., 6 May 1980 (8m, 3f), 14 June 1990 (1m, 3f); Martin Co., 7 May 1980 (2m, 1f); Perquimans Co., 18 Sept. 1980 (2m, 1f); and Pitt Co., 3 June 1990 (1m). VIRGINIA: Chesterfield Co., 12 June 1981 (1m, 1f); Greensville Co., 7 May 1980 (no count); Sussex Co., 12 June 1981 (1m, 1f).

Panorpa gracilis is a vigorous "tumbler," rolling over and over in the net, or dropping readily to the ground when only slightly disturbed. When approached, the insects fly a few inches to a few feet, as most Panorpas, but if alarmed again they fly a short distance, land on a leaf and tumble over the edge to the ground (not to the underside of the leaf).

When he described *P. gracilis*, Carpenter (1931) recognized its structural similarity to *P. interrupta* Banks (now *P. banksiana* Penny and Byers). It is even more similar to *P. palustris* Byers (1958), but this similarity did not occur to me in 1958 because the ventral parameres of *gracilis* were originally described as without barbs. Subsequent examination of the holotype of *gracilis* (Fig. 31) revealed that these parameres do indeed have barbs on the inner, basal 80 per cent of their length, while approximately the apical 20 per cent is bare. In a few pinned males of *gracilis*, one or both ventral parameres are twisted into a position that makes the barbs primarily dorsal and thus not immediately seen in ventral aspect. In *P. banksiana* (Fig. 30), the ventral parameres (which Carpenter, p. 248, inadvertently called hypovalves) are much longer than in *gracilis*, extending far up between the dististyles, and are greatly thickened in their basal two-thirds and essentially bare (i.e., without barbs). See also *P. palustris*.

Since the female of *P. gracilis* has been unknown, the subgenital plate and the genital plates are illustrated here (Figs. 36, 38, 39). Absence of apodemes projecting cephalad from the basal plate is striking, as is also the similarity of the genital plates of *gracilis* to those of *P. palustris* (Figs. 40, 41).

Panorpa palustris Byers

This species is included because of its geographic range; the available dates of its collection are not truly autumnal. It was originally found in mid-September, in southeastern Virginia, at the western edge of the Great Dismal Swamp, then in Nansemond Co., now Suffolk. Subsequently it was collected near Virginia Beach in early September, and more recently in nearby Camden Co., North Carolina, on 18 Sept. 1980 (WB). There are spring and summer records for Caroline, James and Spotsylvania counties in Virginia.

In the form of the dististyles, hypovalves and aedeagus, males of *P. palustris* rather closely resemble those of three other regional species: *gracilis* Carpenter, *dissimilis* Carpenter and *banksiana* Penny and Byers (formerly *interrupta* Banks). Since in all four species the inner basal cup of the dististyle is more or less ventral in position so that its shape can readily be determined, I have illustrated dististyles of all four, side by side, for comparison and identification purposes (Figs. 32-35). This concavity on the dististyle is narrow and shallow in *palustris* (Fig. 35) and is divided by a thin diagonal carina. In preserved specimens, the ends of the ventral parameres usually lie in the groove along the basal side of this carina. There is only a slight indication of such a carina in *dissimilis* (Fig. 33), and the irregular outer, ventral margin of the cup is conspicuously more protruding than in *palustris*, although this curved, ridge-like structure is variable in both species. In *banksiana* and *gracilis* there is no carina, the shape of the cup differs especially in width, and the darkened point on the dorsal margin is more basal in *banksiana*. As pointed out earlier, under *P. gracilis*, the ventral parameres of *banksiana* and *gracilis* are completely different; they are more similar in *palustris* and *dissimilis*.

The female of *P. palustris* has not been described heretofore. Taxonomically useful details are therefore illustrated in Figures 37, 40 and 41.

Panorpa banksiana Penny and Byers

Originally named *Panorpa interrupta* by Banks (1918), this species was re-named (Penny and Byers, 1979) because of its secondary homonymy with *P. interrupta* (Navás, 1913, described as *Aulops* and now a synonym of *P. japonica*). Banks' syntypes are labelled "Raleigh, N.C., Late Sept. 1915, F. Sherman."

Spring records for *banksiana* are more numerous than autumnal ones. There are autumnal collections from the vicinity of Raleigh (Wake Co.), North Carolina, from 23 to 27 September and on 17 October, and from Harnett Co., 27 Sept., Lee Co., 16 Sept., and Duplin Co., 4 Oct., all in North Carolina. Spring records include also Ashe, Henderson, Johnston, Nash, Robeson and Wilson counties, from April to June.

In aedeagal structure and form of the dististyles (Fig. 30), this species belongs to a group together with *P. gracilis, P. palustris* and *P. dissimilis*. See discussion of *P. gracilis*.

Panorpa hispida new species

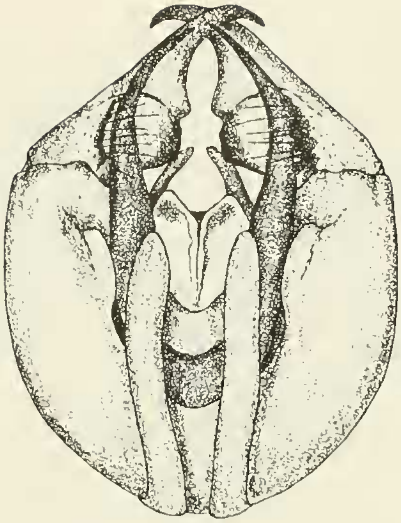
Description based on 26 males, nine females, pinned from alcohol.

Head: Dorsum, frons and rostrum glossy dark yellowish brown, with black ring around base of each ocellus. Maxillary and labial palps yellowish brown except apical one-third to half of each terminal segment dark brown to black. Scape, pedicel and proximal half of first flagellomere yellowish brown, rest of flagellum brownish black; 36-38 flagellomeres (36 in holotype, 38 in allotype).

Thorax: Dorsum evenly light brown, without any pattern of markings; pleural surfaces, coxae and mera dull yellowish brown with sparse yellowish hairs and some darker, longer hairs on anterior surfaces of coxae. Legs dull yellowish brown, with scattered black spines on tibiae; tarsi darkening from dark yellowish brown on basitarsus to almost black on apical tarsomere; terminal ring of black spines on first four tarsomeres.

Wings tinged with yellow to light yellowish brown, bands and spots dark brown. Stigma whitish in specimens mounted from alcohol. Apical band with two or three included pale spots. Pterostigmal band complete but not branched, its distal branch represented by dark spot at margin between M_3 and M_4. Marginal spot small, from C to slightly behind R_1. Basal band interrupted near midlength, anterior part extending from C to M, posterior part from slightly before Cu_1 to wing margin. First basal spot and first humeral spot present.

Abdomen of male: Terga 1-5 unevenly sordid yellowish brown, corresponding sterna paler yellowish brown; sixth segment more uniformly dark yellowish brown, with tergal horn; notal organ only weakly developed, downcurved hairs on posterior edge of tergum 3 slightly darkened and thickened. Genital bulb (Fig. 42) wider than length measured to ends of basistyles. Hypovalves slender, of nearly uniform width throughout but narrowing slightly in apical one-third, with long, slender, dark setae along mesal margins. Inner, ventral apex of each basistyle bearing 2-3 long, thick, black setae, usually divergent from their bases (Fig. 42). Tergum 9 (Fig. 45) with posterior lobes slender, about three times as long as wide, and bearing dark apical setae. Basal cup of dististyle shallow, its inner surface nearly flat, with ventral (posterior) and apical margins strongly sclerotized and slightly darkened; about ten short, black setae along dorsal margin (Fig. 44). Apical one-third of dististyle bent somewhat dorsad, curving evenly to darkened, acute tip. Ventral parameres (Fig. 43) curved dorsad and mesad, densely sclerotized, with barbs along inner margin increasing in length toward apex of paramere. Dorsal parameres slightly darkened at base, pale yellowish at apex, with nearly transparent dorsal appendage hanging down and concealed in ventral aspect. Ventral valves pale, their ventral edges diverging from midline and merging apically with dorsal parameres; dorsal valves inconspicuous, light brown but strongly sclerotized, merging dorsally with black bases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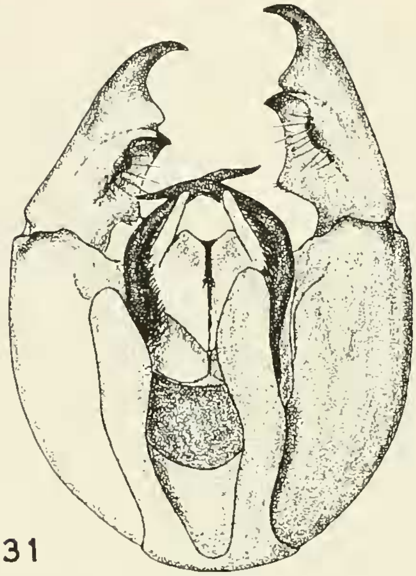
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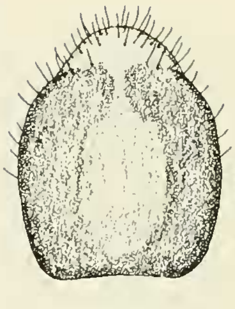
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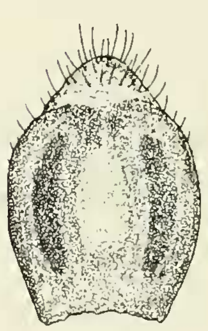
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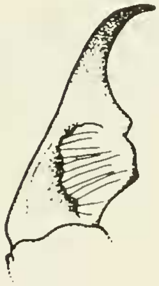
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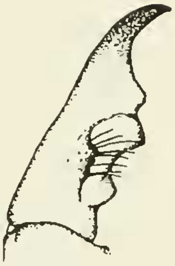
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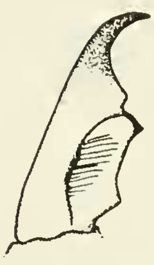
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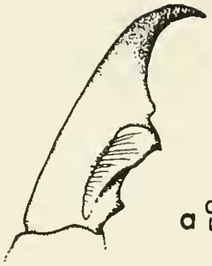
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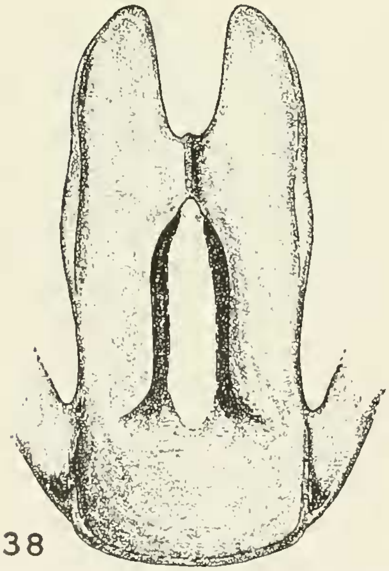
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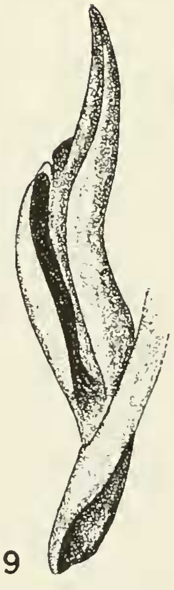
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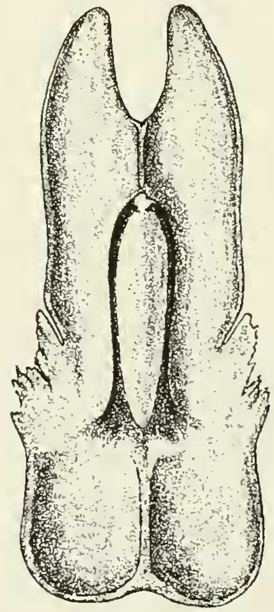
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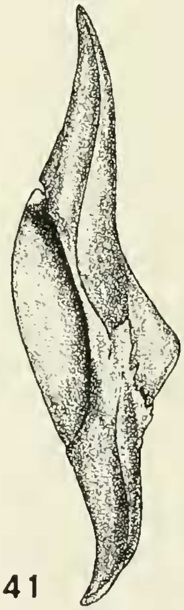
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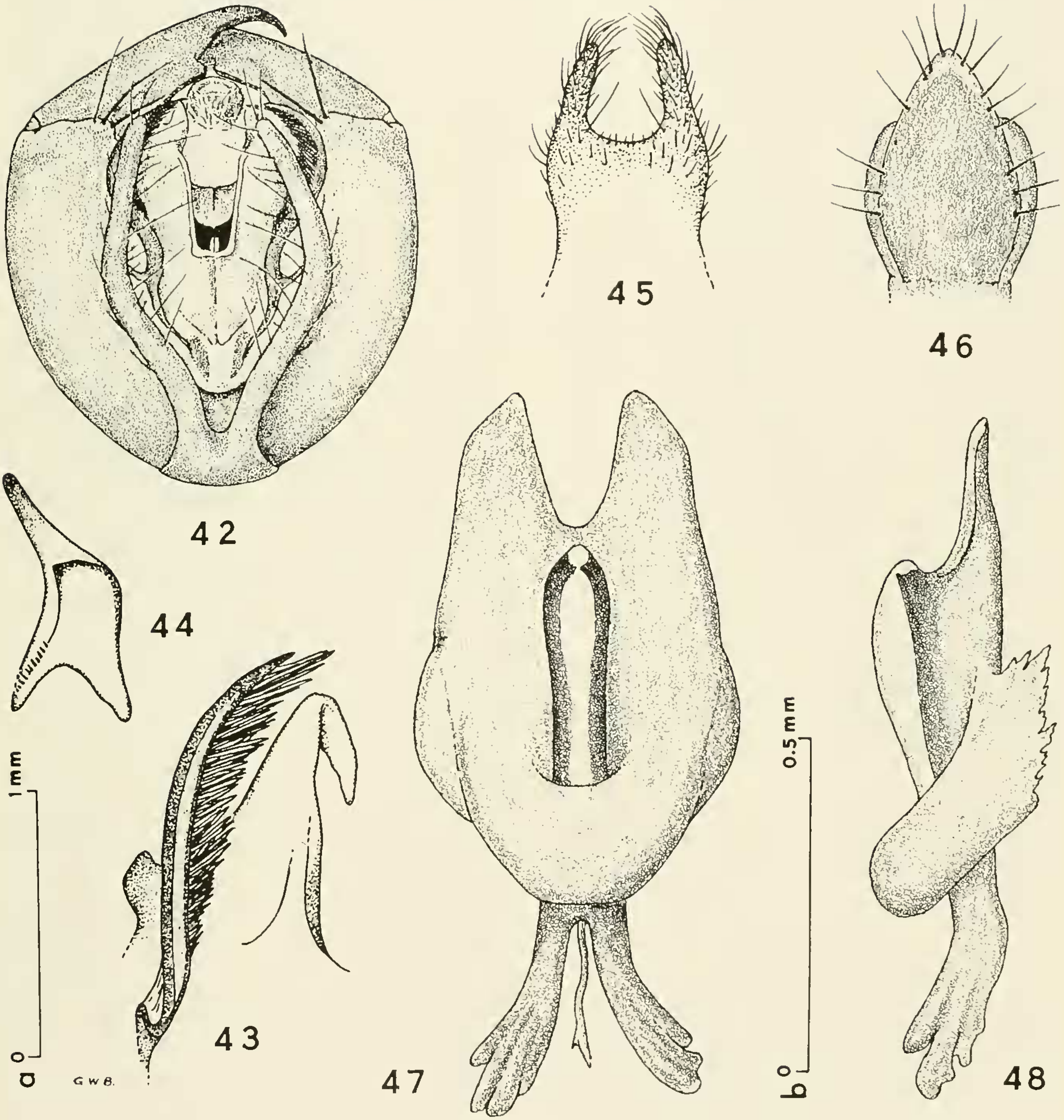
Fig. 30. *Panorpa banksiana* Penny and Byers, genital bulb, male holotype (of *P. interrupta* Banks), ventral aspect. **Figs. 31, 36, 38-39.** *Panorpa gracilis* Carpenter. **31,** genital bulb, male holotype, ventral aspect. **36,** subgenital plate, female, ventral aspect. **38,** genital plate, female, ventral aspect. **39,** same, right lateral aspect. **Figs. 32-35.** *Panorpa* species, left dististyles of males, ventral aspect. **32,** *P. banksiana.* **33,** *P. dissimilis.* **34,** *P. gracilis.* **35,** *P. palustris.* **Figs. 37, 40-41.** *Panorpa palustris* Byers. **37,** subgenital plate, female, ventral aspect. **40,** genital plate, female, ventral aspect. **41,** same, right lateral aspect. Scale a, figs. 30-37; scale b, figs. 38-41.



Figs. 42-48. *Panorpa hispida*, n. sp. **42,** genital bulb, male paratype, ventral aspect. **43,** left ventral and dorsal parameres, ventromesal aspect (making breadth and curvature of ventral paramere less obvious). **44,** right dististyle, mesal aspect. **45,** ninth abdominal tergum, male paratype. **46,** subgenital plate, female allotype, ventral aspect. **47,** genital plate, allotype, ventral aspect. **48,** same, right lateral aspect. Scale a, figs. 42, 44-46; scale b, figs. 43, 47-48.

of dorsal parameres. No aedeagal hamulus. Apex of segment 11 lying between dorsal parameres in most specimens.

Abdomen of female: Both terga and sterna sordid yellowish brown, sterna slightly paler. Segment 10 dark brown, black apically; cerci black. Subgenital plate (Fig. 46) acutely pointed posteriorly, with long, dark setae around margin; laterotergites between subgenital plate and ninth tergum moderately sclerotized, posteriorly rounded, with evenly curved outer surface, often folded in dried specimens. Genital plates (Figs. 47, 48) widest near mid-length, with broad posterior lobes; axial portion not attaining posteromedial margin; apodemes short, less than half as long as plates.

Body length, male, about 10.7-11.6 mm. (holotype 11.3 mm.); female about 10.2-12.0 mm. (allotype 12.0 mm.). Fore wing, male, 10.5-11.8 mm. (holotype 10.5 mm.); female, 11.0-12.4 mm. (allotype 12.4 mm.).

Holotype male, collected 2 miles east of Walterboro, Colleton Co., South Carolina, 29 Oct. 1988, by Wes Bicha. Allotype, 2 miles east of Round O (name of village), Colleton Co., South Carolina, 29 Oct. 1988, Wes Bicha. Paratypes: SOUTH CAROLINA: Bamberg Co., S of Bamberg, 8 Oct. 1988 (2m, 2f); Calhoun Co., 5 mi. S of Sandy Run, 29 Oct. 1988 (1m); Colleton Co., 2 mi. E of Walterboro, 29 Oct. 1988 (4m, 3f), Round O, 29 Oct. 1988 (1m), 7 mi. S of Ruffin, 29 Oct. 1988 (1m, 1f); Edgefield Co., Big Hart Lake State Forest, 14 May 1988 (11m, 1f); Orangeburg Co., Holly Hill, 30 Oct. 1988 (3m); all collected by Wes Bicha; Kershaw Co., Camden, 26 Sept. 1930, T. H. Hubbell (1m, 1f). GEORGIA: Emanuel Co., 3 mi. W of Coleman Lake, 19 May 1989, WB (1m).

Holotype, allotype and 2 male paratypes in the SEM. Other paratypes are in the collection of Wes Bicha, the USNM, and the MCZ.

In structure of the genital bulb of males, *Panorpa hispida* somewhat resembles *P. palustris* Byers and *P. vernalis* Byers. It differs from both these species most conspicuously in wing pattern, having a complete pterostigmal band and the basal band only narrowly broken near its mid-length. The genital bulb is relatively much wider in *hispida* (width greater than height to apices of basistyles), and the ventral parameres have barbs along the mesal edge only (as in *vernalis* but differing from *palustris*). The thick apical setae of the basistyles are longer but fewer in number than those of *vernalis* and are divergent rather than subparallel (absent in *palustris*). The basistyles are much more deeply separated ventrally than in *palustris*; and the hypovalves are more widely divergent than in *vernalis*. Presence of laterotergites with smoothly curved outer surfaces (as contrasted with the convoluted, densely sclerotized laterotergites in females of many species) is diagnostic for females of *hispida*.

The name *hispida* (Latin, bristly) refers to the long, thick, black setae on the inner, ventral apex of the basistyle, as well as to the marginal setae of the hypovalves of the male, longer and darker than their counterparts in most species, and the setae on the subgenital plate of the female.

Panorpa scopulifera new species

Description based on 23 males, 8 females, pinned (12m, 3f of these originally preserved in alcohol).

Head: Dorsum, frons and most of rostrum dark yellowish brown; narrow dark brown zone around ocelli; apex of rostrum, including maxillary palps, usually brown. Scape, pedicel and basal half of first flagellomere sordid yellowish brown; flagellum dark brown to black, with 36 (holotype) to 40 flagellomeres, usually 36-37.

Thorax: Dorsum sordid dark yellowish brown without distinct markings; pleural surfaces, coxae and mera dull yellowish brown with scattered pale setae and a few dark setae on anterior surfaces of fore and middle coxae; legs yellowish brown with dark setae; tarsi slightly darker than legs except fifth tarsomeres dark gray.

Wings strongly tinged with pale yellowish brown, with brown markings. Apical band usually entire, with one or two small included pale spots in two autumnal males, two or more in all vernal individuals. Pterostigmal band complete but narrow near mid-length, not forked but apical branch represented by spot at posterior margin between M_3 and M_4. Marginal spot present, variable in extent, usually interrupted between R_{2+3} and R_{4+5} (holotype), thus two separate spots, that bordering R_{4+5} very small. Basal band usually broken behind M (holotype), otherwise extremely slender near mid-length. First basal and first humeral spots present.

Abdomen of male: All terga and sterna unevenly yellowish brown; tergal horn on sixth segment usually slender and slightly downcurved (holotype), more stout in a few males. Notal organ weakly developed, a broadly rounded median lobe bearing decurved black hairs, on tergum 3, and small peg on tergum 4. Genital bulb (Fig. 49) slightly wider than its length to ends of basistyles. Hypovalves slender, narrowing slightly toward tips, extending to ends of basistyles or somewhat shorter, divergent near base, with long hairs on mesal margins and scattered shorter hairs. Tergum 9 with two slender apical lobes slightly inclined toward each other, emargination between them roughly U-shaped. Cerci short, extending slightly from beneath ninth tergum. Basistyles with 1-4 thick, black, subparallel setae at ventromesal apex (2 on each basistyle in holotype, 2-3 in most males). Dististyles of roughly uniform thickness in basal two-thirds, then narrowing and curving to strongly sclerotized, acute apex. Inner basal cup shallow, with darkened rim produced to form short, blunt tooth on dorsomesal edge; about 12 short, sharply pointed, black setae along dorsal edge of cup near base of dististyle. Ventral parameres flattened, blade-like, abruptly narrowed shortly before acute apex, with barbs along inner edge only, increasing in length toward apex, longest ones extending only to ends of basistyles; free end of paramere not conspicuously curved, most darkly sclerotized along lateral margin. Dorsal parameres moderately sclerotized, palest toward apex, with thin-walled dorsal appendage directed toward base of aedeagus. Ventral valves pale, merging laterally with dorsal parameres; dorsal valves small, pale. No aedeagal hamulus, but sclerotized band connecting ventral parameres slightly thickened near mid-line.

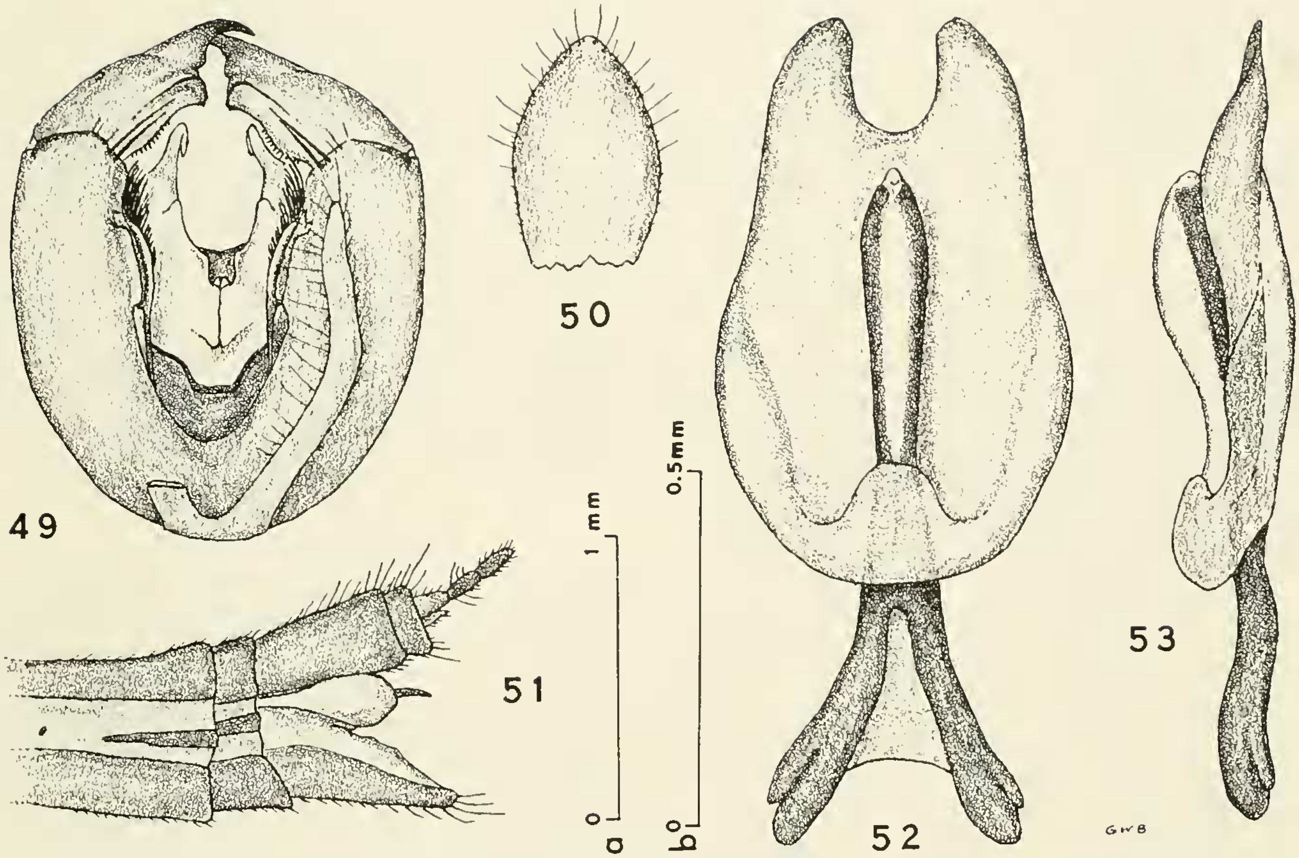
Abdomen of female: All terga and sterna unevenly sordid yellowish brown, darker in specimens pinned soon after capture (e.g., allotype). Cerci dark brown basally, terminal segment black. Subgenital plate (Fig. 50) rounded at apex. Prominent laterotergite at each side below ninth tergum, yellowish brown to pale brown, evenly rounded posteriorly (Fig. 51). Genital plates (Figs. 52, 53) with broad posterior lobes, median notch U-shaped; axial portion not extending to margin of notch; basal plate somewhat swollen (thickened) along lateral margins; apodemes only moderately divergent.

Body length, male, about 9 to 13 mm. (holotype 10.9 mm.); female, about 9 to 11 mm. (allotype 9.1 mm.). Length of fore wing, male, 10.1 to 12.5 mm. (holotype 11.5 mm.); female, 11.4 to 12.2 mm. (allotype 11.4 mm.). Individuals collected in spring are noticeably larger than autumnal ones.

Holotype male and allotype, 3 miles south-southwest of Mountsville, Laurens Co., South Carolina, 5 October 1977, George W. Byers (field cat., Laurens Co. no. 1). Paratypes: SOUTH CAROLINA: same data as holotype (4m, 3f); Laurens Co., Sumter National Forest, 9 mi. east of Clinton, 5 Oct. 1977, GWB (3m, 1f); Laurens Co., Laurens, 15 Sept. 1980, WB (2m); same but 27 May 1988, WB (3m, 3f); Abbeville Co., 15 Sept. 1980, WB (2m); Abbeville Co., Calhoun Falls, 29 May 1978, GWB (1 m); Anderson Co., 8 mi. N of Anderson, 1 Sept. 1991, WB (3m); Chester Co., 27 May 1984, WB (1m); Newberry Co., Whitmire, 6 and 27 May 1988, WB (2m); McCormick Co., Savannah River at U.S. Hwy. 378, 4 Oct. 1977, GWB (1m). GEORGIA: Franklin Co., 1 Sept. 1984, WB (1m); 2 mi. S of Carnesville, 15 Sept. 1991, WB (1m).

Holotype, allotype and 4 male, 3 female paratypes are in the SEM. Other paratypes are in collection of Wes Bicha, in the USNM, and the MCZ.

Panorpa scopulifera is very similar to *P. hispida* in most details of



Figs. 49-53. *Panorpa scopulifera*, n. sp. **49,** genital bulb, male holotype, ventral aspect; left hypovalve omitted. **50,** subgenital plate, female allotype, ventral aspect. **51,** terminal abdominal segments (8-11), allotype, left lateral aspect, to show laterotergite. **52,** genital plate, allotype, ventral aspect. **53,** same, right lateral aspect. Scale a, figs. 49-51; scale b, figs. 52-53.

structure and color, and the two are presumed to be closely related. The striking difference in males is that the ventral parameres are much shorter in *scopulifera*. (Latin *scopula* = a small brush or broom + ferre = to bear, referring to the short, brush-like ventral parameres.) Females of *scopulifera* may be recognized by their short, rounded laterotergites, which, however, resemble those of *P. pachymera*, n. sp., a regional species occurring farther to the west. In some dried specimens, the laterotergites may not be readily visible because of the upturned edges of the subgenital plate.

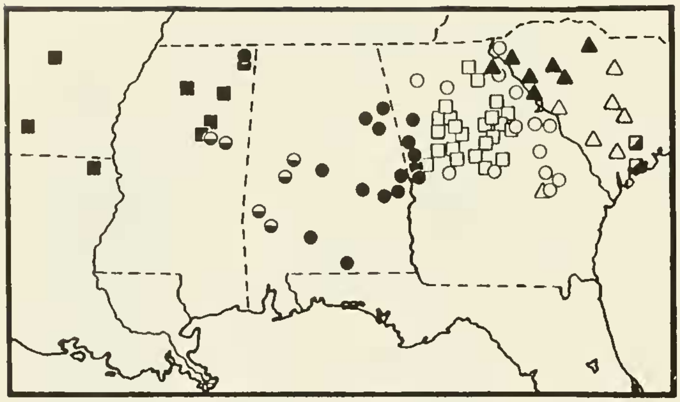
Available specimens of *P. scopulifera* and *P. hispida* indicate separate, rather limited ranges, *scopulifera* being a species of the piedmont and *hispida* occurring on the coastal plain (Map 5). Collecting to date has not yielded any specimens from the intervening area, but in the future these two forms may prove to be only subspecies of a single species.

At the type locality, *Panorpa scopulifera* was found on shaded clumps of honeysuckle in an undergrowth including also brambles, some woodbine (Virginia creeper) and young saplings of pine and red gum, in a wooded area composed almost wholly of pines. At another site in Laurens Co., South Carolina, and in McCormick Co., the habitat was nearly the same except that the woods included some more mature red gum trees and a few oaks and hickories, and the undergrowth included poison ivy, also trumpet vine (*Campsis radicans*) growing across the ground and up tree trunks. The occurrence of this and several other species of *Panorpa* in the Southeast on honeysuckle, poison ivy and associated broad-leaved plants possibly relates to (1) retention of moisture beneath such thickets, amid generally dry surroundings, (2) a concentration of other kinds of insects that, when dead, are the food of scorpionflies, and (3) presence of nearly horizontal leaf surfaces on which to stand.

Panorpa rufescens Rambur

This species has been reported from several southeastern states, including Florida, Georgia, North Carolina and Virginia (Carpenter, 1931) and Mississippi (Byers, 1962a), in addition to its northeastern range: New England states, New York, Pennsylvania, New Jersey and Maryland. Carpenter illustrated the male of *rufescens* (1931, fig. 20) as having very short, mesally curved ventral parameres with short apical barbs. This is the form found in the Northeast. Males from the southeastern states were found to have considerably longer ventral parameres, which, however, were shorter than those of nearly all other nearctic species and did not extend to the level of the outer ends of the basistyles. In wing maculation and other characters, these two forms were inseparable. Either of them would be identified as *rufescens* by existing keys. I have seen spring specimens of the northeastern form from as far south as eastern Virginia.

There is nothing in Rambur's description of *rufescens* that will differentiate it from several other species in which males have a horn-like process on the sixth abdominal segment. Accordingly,



Map 5. Geographical distribution of new species in the *Panorpa rufescens* group in southeastern United States. Solid circles - *P. ferruginea*; open circles - *P. pachymera*; half-shaded circles - *P. confinis*; open triangles - *P. hispida*; solid triangles - *P. scopulifera*; open squares - *P. acuminata*; half-shaded squares - *P. planicola*; solid squares - *P. rupeculana*. Each symbol represents one or more collections in a county.

it was necessary to refer to Rambur's type specimens, supposedly in the collection of Baron de Selys-Longchamps, in the Institut Royal des Sciences Naturelles de Belgique, Brussels. While three of the nine specimens of *rufescens* in the Selys collection are labelled "Coll. Latreille," none has any similar indication that it was formerly in the Rambur collection. One damaged male, however, is labelled "Am. Sept."; and Rambur said of *rufescens* "habite l'Amérique septentrionale." Following publication of his revision of the nearctic Mecoptera, in 1931, Carpenter had occasion to examine the specimens in the Selys collection. It was his opinion that none of the specimens in that collection was an original Rambur type (Carpenter, 1939) since none was labelled as a type. Years later, however, I found that one male (in a series of 3m, 5f and 1 without abdomen) did in fact bear a label, apparently attached by Esben-Petersen, ca. 1920, reading "Figure of appendices male, Type specimen," as well as others. Accepting Esben-Petersen's judgment, I designated this male as the lectotype of *rufescens* (Byers, 1962b).

Unfortunately, as it has turned out, the lectotype is a male of the southeastern form, that is, the form having somewhat longer ventral parameres with longer barbs on them. This selection was unfortunate because I now think that the northeastern form and the southeastern form are two different species. Carpenter must have noticed that the supposed type he examined was not the same, in detail, as what he had identified as *rufescens*. Having decided that it was not really the type, he wrote (Carpenter, 1939), "This opens again the question of the identity of *rufescens*, the type apparently being lost. It seems advisable, under the circumstances, to recognize *rufescens* as it has been treated in the past by Banks and myself."

At present, I agree with this view. The lectotype (i.e., the same individual that Esben-Petersen had labelled as "Type specimen" but that Carpenter rejected as an original type) does not appear to have been one of Rambur's specimens. It is, in fact, one of those labelled "Coll. Latreille." Although the "Neuroptera" from both Rambur's and Latreille's collections are now part of the Selys collection, I can find no indication that Rambur ever examined Latreille's specimens. And if the lectotype is not an original syntype, it has no status as a lectotype (Article 74a[v] of the International Code of Zoological Nomenclature).

Accordingly, the name *rufescens* needs to be associated with a neotype, since no original type is known to exist. And I agree with Carpenter that this should be a specimen of the northeastern form that was identified as *rufescens* by Banks and by Carpenter himself (cf. Figs. 63, 64). I have therefore selected as neotype a male that is pinned but otherwise intact in every respect and bears the following labels: "Laurel Lake, nr. Jacksonville, Vt., 10-VIII-1978, H. D. Pratt" and "*Panorpa rufescens* Rambur, Det. G. W. Byers 1985," in addition to a red label stating that this individual is the neotype. (Jacksonville is in Windham County, Vermont, about 6.4 km. north of the border with Massachusetts.) The specimen agrees in detail with the description and figures of *rufescens* in Carpenter's revision (1931: 236, fig. 20 - genital bulb of male, and fig. 83 - wing); it also agrees with the much more general description by Rambur. The neotype is in the SEM, to which it was generously contributed by Dr. Harry D. Pratt several years ago.

That being done, the southeastern form is left without a name. Following is its taxonomic description:

Panorpa ferruginea new species

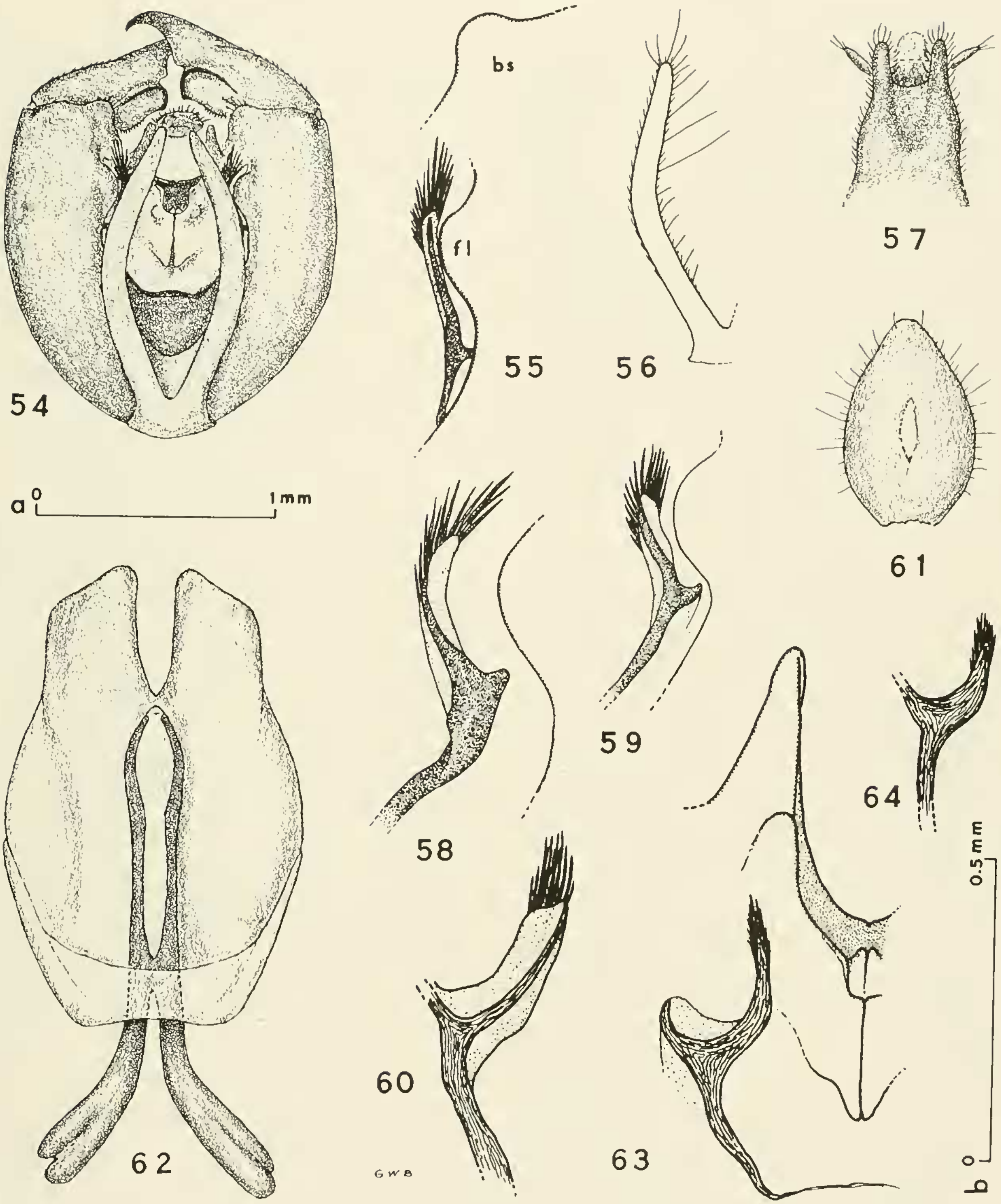
Description based on 51 males, 27 females, pinned.

Head: Dorsum, frons and rostrum (including palps) dark amber brown; dark ring around each ocellus. Scape, pedicel and most of basal flagellomere dark yellowish brown; flagellum black, with 37-41 flagellomeres (average 38).

Thorax: Dorsum unevenly dark yellowish brown, without distinct markings; pleural surfaces, coxae and mera dark yellowish brown with fine, silvery pubescence on mesothorax and metathorax and scattered yellowish hairs, longest and most dense on anterior surfaces of coxae; a few black setae on anterior surface of middle coxae and, in several individuals, across anterior, apical edges of hind coxae. Legs and tarsi dark yellowish brown, except fifth tarsomeres somewhat blackened.

Wings strongly tinged with yellowish brown, with dark brown bands and spots. Apical band entire, rarely with a small included pale spot. Pterostigmal band complete, often narrowed just behind M$_{1+2}$, unbranched but outer branch represented by spot at wing margin between M$_3$ and M$_4$. Marginal spot slender, extending from C to slightly behind R$_{4+5}$ or interrupted near R$_{2+3}$ to form two spots. Basal band usually interrupted near M to Cu$_1$, unbroken but narrowly constricted near M in a few individuals. Anterior basal spot present, approximately R to Cu$_2$; faint indication of posterior basal spot near end of A$_2$. First humeral spot present, slightly beyond h.

Abdomen of male: Terga 2-5 unevenly yellowish brown, corresponding sterna pale yellowish brown; tergal horn on segment 6 longer than width at base (lateral aspect), tip slightly downcurved; notal organ weakly developed, with sparse, decurved, black hairs on middle posterior margin of tergum 3 and (usually concealed) sclerotized peg on tergum 4. Genital bulb (Fig. 54) broad, slightly wider across apices of basistyles than length of bulb excluding dististyles. Hypovalves slender, widest near mid-length, then tapering toward narrowly rounded apex, extending almost to tips of basistyles; some hairs on mesal margins 2-3 times as long as width of hypovalve (Fig. 56). Tergum 9 (Fig. 57) with U-shaped emargination; apical setae on posterolateral lobes black, strongly curved mesad. Inner, apical margin of basistyle a broadly rounded lobe with a few hairs but without thick, black setae (holotype), or rarely with one or two such setae. Basistylar flange thin, rounded. Dististyles thick in basal two-thirds, narrowing and curving evenly to acute, densely sclerotized apex. Inner basal cup of dististyle shallow, its margin darkly sclerotized except near base, with low, angular, dorso-mesal tooth and row of 9-14 short, thick, sharply pointed setae along dorsal margin. Ventral parameres (Fig. 55) short, their terminal barbs not reaching or barely reaching apex of basistyles; free portion (beyond lateral branch) acutely tipped,



Figs. 54-62. *Panorpa ferruginea*, n. sp. **54,** genital bulb, male holotype, ventral aspect (most hairs omitted). **55,** right ventral paramere, holotype, shown in relation to basistylar flange (fl) and ventro-mesal apex of basistyle (bs). **56,** left hypovalve, holotype, showing relative lengths of marginal setae. **57,** ninth abdominal tergum, tergum 10 (partially concealed), tergum 11 (indicated by dashed line) and cerci, paratype from Heard Co., Georgia. **58,** right ventral paramere, paratype from Covington Co., Alabama, shown in relation to basistylar flange. **59,** same, paratype from Lee Co., Alabama. **60,** left ventral paramere, paratype from Heard Co., Georgia (most atypical form assigned to this species). **61,** subgenital plate, female allotype, ventral aspect. **62,** genital plate, allotype, ventral aspect. **Figs. 63-64.** *Panorpa rufescens* Rambur. **63,** left ventral paramere, shown in relation to dorsal paramere, ventral and dorsal valves of aedeagus, male from Framingham, Massachusetts. **64,** left ventral paramere, male from Williamsburg, Virginia. Scale a, figs. 54, 56-57, 61; scale b, figs. 55, 58-60, 62-64.

bowed ventrad, with few (4-8) barbs on outer surface shortly before tip but greater number along inner and dorsal surfaces and directed primarily dorsad (thus sometimes not easily seen in ventral, or posterior, aspect); terminal barbs often appressed to basistyle in dried specimens. Dorsal parameres dark brown mesally near base, paler toward apex yet firmly sclerotized, with lightly sclerotized dorsal appendage bent back toward base of aedeagus. Ventral valves only slightly sclerotized, together forming a V-shaped structure usually projecting from ventral surface of aedeagus (holotype), less often barely projecting. Aedeagal hamulus absent, but sclerotized band between ventral parameres slightly widened near mid-line. Segments 10 and 11 (telescoped into 10) usually clearly visible between bases of dististyles; cerci short.

Abdomen of female: Terga and sterna unevenly sordid dark yellowish brown; cerci black. Subgenital plate nearly flat, with upturned edges, its pointed or narrowly rounded apex bent downward in some dried specimens; longer marginal setae about one-fourth to one-third of greatest width of plate; an elliptical, weakly sclerotized, nearly transparent area (Fig. 61) on mid-line near mid-length of plate (between opaque structures on dorsal surface of plate). No laterotergites. Genital plates (Fig. 62) generally as in *P. rufescens*, widest near mid-length, with apical (posterior) projections of distal plate broad, their posterior margins slanting cephalad and laterad from apices; long-oval swelling at each side, on ventral surface of basal plate; axial portion almost reaching posterior margin of apical plate in narrow median notch; apodemes widely divergent laterad.

Body length, male, approximately 10 to 12 mm. (holotype 11.6 mm.); female, about 7.7 to 11 mm. (allotype 10.4 mm). Length of fore wing, male, 9.4-11.7 mm. (holotype 10.9 mm.); female, 8.7-11.8 mm. (allotype 10.1 mm.).

Holotype male, 1 mi. N of Fairfax, Chambers Co., Alabama, 1 October 1977, George W. Byers (field cat. no. 1). Allotype and 5m, 4f paratypes, same data as holotype. Additional paratypes: ALABAMA: Bibb Co., Woodstock 5 Sept. 1987, WB (1m); Calhoun Co., E of Piedmont, 13 Sept. 1980, WB (1m); Chambers Co., Fairfax, 24 Sept. 1988, WB (2m); Cherokee Co., 1 mi. SW of Gaylesville, 1 Oct. 1988, WB (1m, 2f); Covington Co., Wing (Conecuh National Forest), 24 Oct. 1985, WB (2m); Elmore Co., 6 mi W of Wetumpka, hwy. 14, 29 Sept. 1977, GWB (3m, 3f); Etowah Co., 29 May 1989, WB (1m); Lee Co., Wilmore Lake, 3 mi. SE of Auburn, 30 Sept. 1977, GWB (1m, 1f), Auburn, SW edge of Auburn Univ. campus, 30 Sept. 1977, GWB (6f); Macon Co., Tuskegee, 20 Oct. 1984, WB (1m), 5 Sept. 1987, WB (2m), 6 Sept. 1987, WB (2m); Monroe Co., Little River State Park, 24 May 1986, WB (1m). GEORGIA: Carroll Co., Tanner State Park, 30 Aug. 1984, WB (1f); Harris Co., W of Pine Mountain, 25 Sept. 1988, WB (1m); Heard Co., Glovers Creek, 30 Aug. 1984, WB (5m); Heard Co., 18 Sept. 1988, WB (3m), 24 Sept. 1988, WB (9m, 1f); Paulding Co., W of Dallas, 30 Aug. 1984, WB (2m), 30 Sept. 1984, WB (1m); Troup Co., 2 mi. NE of West Point, 1 Oct. 1977, GWB (7m, 8f). MISSISSIPPI: Alcorn Co., 11 mi. SE of Corinth, 7 June 1958, GWB (2m, 3f).

Holotype, allotype and 30 paratypes are in the SEM; other paratypes in WB collection and in the USNM, UMMZ and MCZ.

Of all the "*rufescens*-like" scorpion-flies in the southeastern states, *P. ferruginea* has the closest resemblance to *rufescens* because of the short, slender ventral parameres in the male, in addition to more obvious characters such as wing maculation and shapes of dististyles and hypovalves (Figs. 63, 64). The genital plates of females also rather closely resemble those of *rufescens*. Either sex would be identified as *rufescens* by existing keys.

The most closely related species, however, appears to be *Panorpa confinis* n. sp., which like *ferruginea* has short ventral parameres. Unlike *ferruginea*, *P. confinis* has two or three conspicuous thick, black setae on the inner, ventral apex of each basistyle, and the ventral parameres are so short and so close against the basistyles that they are often concealed from view by the hypovalves.

In males judged to belong to *P. ferruginea*, there is some variation in the ventral parameres, as shown in figures 55, 58-60. Part of such variation is probably a result of uneven shrinkage of the membranous parts and consequent bending and twisting of these parameres. But there is also noticeable variation in the number of barbs. In some males, the basal parts of the ventral valves of the aedeagus protrude somewhat ventrad, while in others they remain approximately at the level of surrounding membranous areas. This difference also appears to be a post-mortem result of preservation.

The habitat at the type locality fairly represents the kinds of places where *P. ferruginea* has been found. It was a pine woods with a scattering of red gum, hickory and oak trees, with dogwood as a common understory tree. Much of the ground was covered with fallen dried pine needles. The Panorpas (both *ferruginea* and *neglecta*) were taken from dense growths of honeysuckle, brambles and greenbriars, mainly in areas that on sunny days would be shaded (the sky was completely overcast at the time of collection, yet bright).

Panorpa confinis **new species**

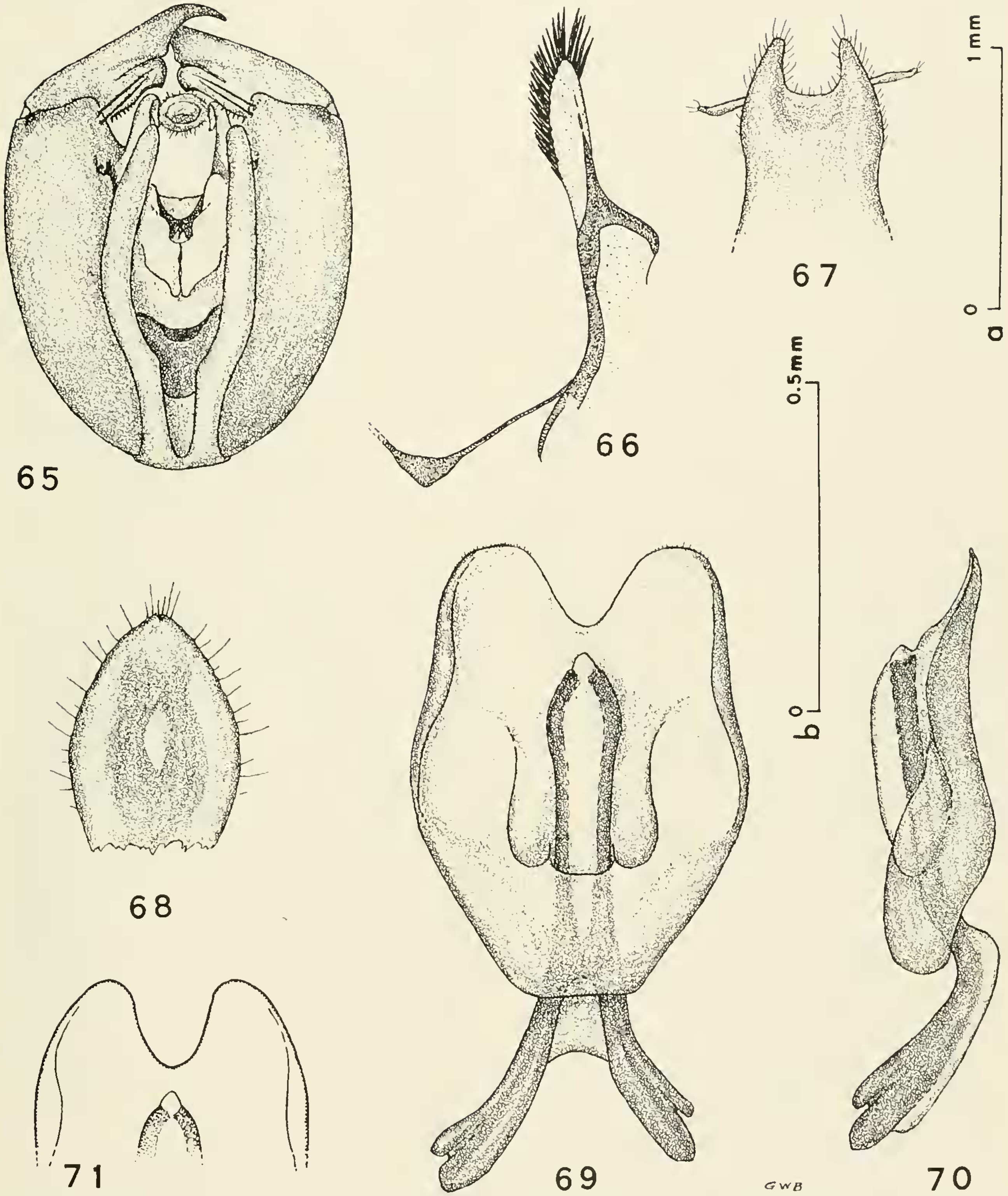
Description based on 12 males, 11 females, pinned (4 of the males initially preserved in alcohol), 10 males, 5 females in alcohol.

Head: Dorsum, frons and rostrum dark yellowish brown (holotype) to unevenly dark amber brown except black crescent above each ocellus; maxillary and labial palps amber brown, apical half of each terminal segment dark brown to black. Scape amber brown, pedicel and first flagellomere a little darker, blackened apically in some specimens; flagellum black, with 36-39 flagellomeres (holotype 38).

Thorax: Dorsum unevenly sordid dark yellowish brown, without any pattern of markings; pleural surfaces, coxae and mera dark yellowish brown in specimens pinned soon after capture, much paler in those preserved in alcohol; fine whitish pubescence on sides of mesothorax and metathorax; scattered golden-yellow hairs longest and most dense on anterior surfaces of coxae; a few dark hairs among yellow ones near apex of middle coxae. Legs yellowish brown, tarsi only slightly darker, with chiefly yellowish hairs.

Wings tinged with pale yellowish brown to light grayish brown, bands and spots brown to dark brown. Apical band with included pale areas variable in number and extent and concentrated near apical margin of wing; band fragmented in some specimens (including holotype), especially those collected in spring, complete in some autumnal ones. Pterostigmal band complete but usually very narrow at M_{1+2}, unbranched but outer branch represented by small spot between M_3 and M_4 near wing margin. Marginal spot small, usually between C and R_{2+3}; small spot also behind R_{4+5}, enclosing nygma. Basal band narrowly to widely interrupted near mid-length, generally between M and Cu_1, thus represented by two spots. Anterior basal spot and first humeral spot both present but latter very small in most specimens.

Abdomen of male: Terga 2-5 unevenly yellowish brown, corresponding sterna slightly paler; segments 6-9 amber brown; tergal horn on segment 6. Notal organ weakly developed, with numerous stiff, decurved black hairs on ventral and posterior surfaces of broad, slightly protruding median lobe on tergum 3 and short, sclerotized peg on anterior tergum 4. Genital bulb (Fig. 65) slightly longer than wide (dististyles excluded). Hypovalves deeply separated, narrowest in basal one-third, tapering slightly toward apex; about 15-20 long, thin, blackened setae along inner margin and on apex of each hypovalve, most a little more than twice width of hypovalve. Tergum 9 (Fig. 67) with posterior lobes roughly triangular, twice as wide at base as at mid-length; marginal setae fairly evenly distributed. Inner subapical surface of each basistyle with 2-4 (usually 2, as in holotype) thick, black setae extending into basal cups of dististyles. Flange on basistyle widest apically,



Figs. 65-71. *Panorpa confinis*, n. sp. **65,** genital bulb, male holotype, ventral aspect (most hairs omitted). **66,** right ventral paramere, topotypic male paratype, ventral aspect. **67,** ninth abdominal tergum, male paratype. **68,** subgenital plate, female allotype, ventral aspect. **69,** genital plate, allotype, ventral aspect. **70,** same, right lateral aspect. **71,** distal (apical) plate, female from Choctaw Co., Mississippi, showing narrower, less bluntly rounded posterior lobes. Scale a, figs. 65, 67-68; scale b, figs. 66, 69-71.

tapering basad. Outer surface of dististyles nearly straight to slightly concave before mid-length; apical one-third darkened, evenly curved toward tip. Inner basal cup of dististyle shallow, with darkly sclerotized margin except toward base, with low dorso-mesal tooth (or angle) and 6-9 sharply tipped, short, black setae along dorsal margin near base. Ventral parameres (Fig. 66), short, with darkly sclerotized ventral band in free portion not reaching tip; paramere somewhat spatulate in fluid-preserved males but variously distorted in dried specimens; position usually near inner wall of basistyle, with terminal barbs not extending far beyond flange; 4-6 barbs on outer subapical edge, larger number along inner (or dorsal) edge. Dorsal parameres moderately sclerotized basally, yellowish toward apex, with flat, lightly sclerotized apical appendage bent back toward base of aedeagus. Ventral valves pale, near-white to slightly yellowish. Aedeagal hamulus absent, but sclerotized band connnecting ventral parameres noticeably widened medially (Fig. 66). Segments 10 and 11 usually visible between bases of dististyles; cerci prominent.

Abdomen of female: Terga and sterna unevenly dark yellowish brown to brown; cerci brown near base, mostly black. Subgenital plate (Fig. 68) broad at base, subacute at apex, with elliptical translucent area near middle (between more opaque structures on dorsal surface); long marginal setae sparse. Laterotergites small, concealed in pinned specimens, not easily visible in fluid-preserved females, connected broadly to sclerotized folds partially enclosing genital plates. Apical genital plate (Fig. 69) with broadly rounded (allotype) to more narrowly rounded (Fig. 71) or bluntly pointed posterior lobes; axial portion abruptly curved above basal plate in lateral aspect, apical end not reaching margin of U-shaped or broadly V-shaped median notch; longitudinal swelling at either side of axial portion (ventral aspect), in addition to marginal swelling of basal plate; apodemes widely divergent, with lightly sclerotized dorsal ridge on each (Fig. 70), making apodemes appear unusually thick.

Body length, male, about 9 to 13 mm. (holotype 11.2 mm.); female, about 9.5 to 12 mm. (allotype 9.1 mm.). Length of front wing, male, 9.3 to 11.6 mm. (holotype 11.0 mm.); female, 10.3 to 12.0 mm. (allotype 11.2 mm.). In general, autumnal individuals slightly smaller than spring ones.

Holotype male, Payne Lake, 24 mi. SE of Tuscaloosa, Hale Co., Alabama, 25 May 1978, G. W. Byers and C. W. Young (GWB field cat., Hale Co. no. 1). Allotype female, Talladega National Forest, 3 mi. E of Duncanville, Tuscaloosa Co., Alabama, 29 Sept. 1977, G. W. Byers. Additional paratypes: ALABAMA: Hale Co., same data as holotype (14m, 6f); Tuscaloosa Co., same data as allotype (3m, 2f); Choctaw Co., 0.3 mi. E of Butler, 11 April 1982, WB (2m); Clarke Co., Coffeeville, 11 April 1982, WB (2m). MISSISSIPPI: Choctaw Co., Ackerman, 24 Sept. 1977, GWB (3f); Oktibbeha Co., State College, 16 Nov. 1981, W. H. Cross (1f), 20 April 1950, R. Humphrey (1f), 10 April 1961, J. Boyd (1f), 24 June 1961, M. J. Wade (1f).

Holotype, allotype and most paratypes are in the SEM. Four paratypes in collection of Wes Bicha, one in Mississippi State University.

Panorpa confinis has both an autumnal and a vernal flight period, that is, two generations a year. The holotype was selected from the late May collection because of its better condition.

This species seems to bear much the same sort of relationship to *P. ferruginea* as *P. insolens* Carpenter does to *P. helena* Byers. That is, the most conspicuous difference is that males of *confinis* have thick, black setae on the inner, apical surface of the basistyle, whereas those of *ferruginea* do not. There are apparently also minor but consistent differences in the shapes of the ventral parameres and the basistylar flanges. The ventral parameres somewhat resemble those of *P. vernalis*, which is known from southwestern Mississippi, but are shorter in *confinis* and have the sclerotized band abbreviated. Also the wing markings are very different in these two species. In females, the swellings alongside the axial portion of the genital plates, the rounded lobes on the apical plate (as contrasted with diagonally truncate in *ferruginea*), and the abrupt bend in the axial portion above the basal plate are diagnostic for *confinis*.

Panorpa confinis takes its name (Latin *confinis* = adjoining, lying adjacent, or neighboring) from the fact that its range as now known is contiguous with that of *ferruginea*. Not only is *ferruginea* geographically its nearest neighbor but also apparently its nearest kin, to judge from similarity of structure and color. Future biological investigations may show that *confinis* and *ferruginea* are only geographical races of a single species.

Panorpa pachymera new species

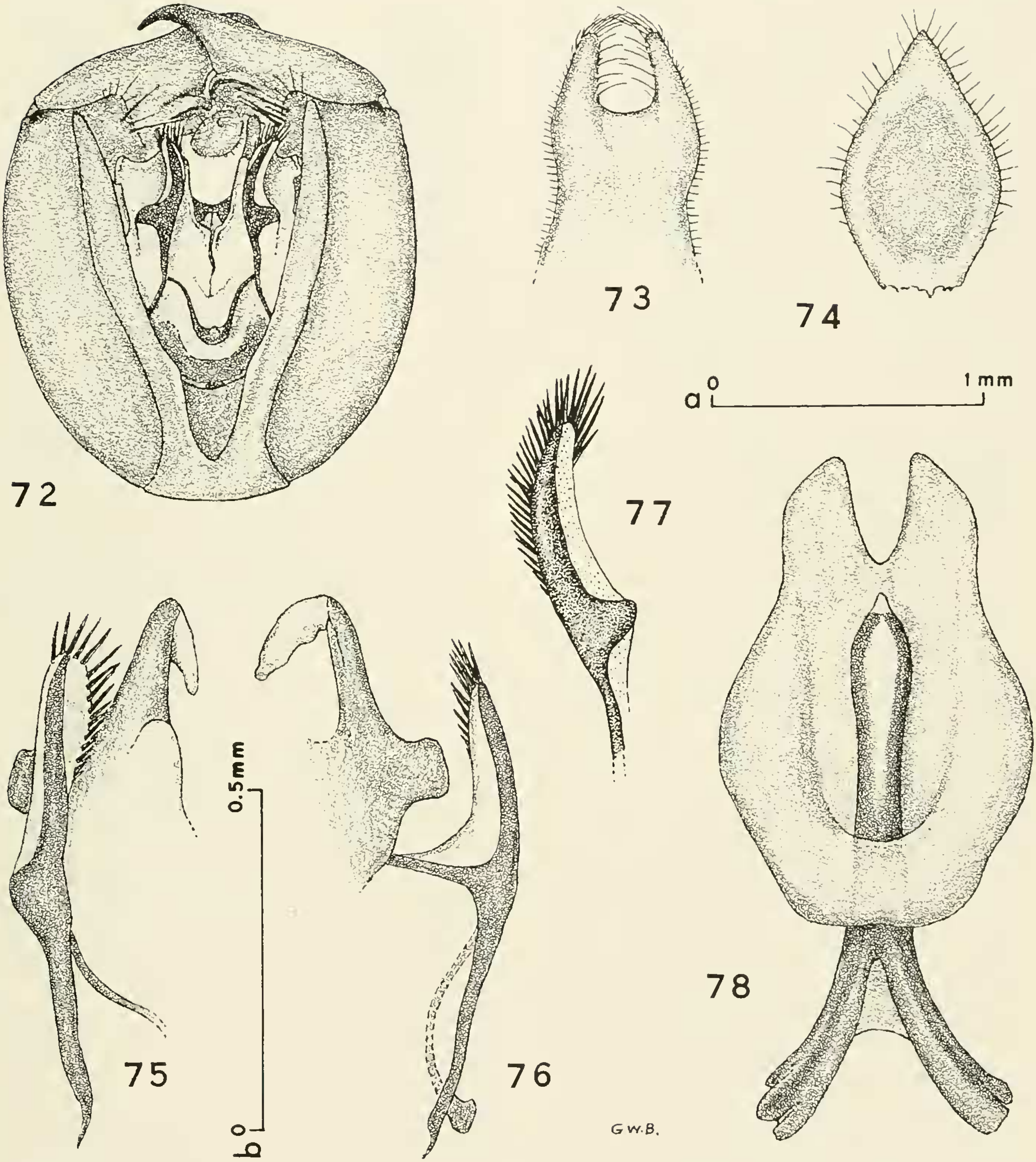
Description based on 66 males, 12 females, pinned but most initially preserved in alcohol.

Head: Uniformly amber brown except for blackened crescent above each ocellus and yellowish brown on sides of rostrum near apex. Maxillary and labial palps yellowish brown with darkened tips. Scape and pedicel dark yellowish brown, flagellum black except base of first flagellomere brown; 37-38 flagellomeres (holotype 38, right antenna broken at 25th flagellomere).

Thorax: Dorsum unevenly sordid grayish brown, without any distinct markings; pleural surfaces, coxae and mera yellowish brown with fine whitish pubescence on mesothorax and metathorax and scattered dark yellowish hairs longest and most dense on anterior surfaces of coxae; sparse black setae on anterior, subapical surfaces of middle coxae and along apical edges of hind coxae. Legs and tarsi yellowish brown, especially tarsi appearing darker because of abundant, small black setae.

Wings moderately to strongly tinged with yellowish brown, bands and spots dark brown. Apical band entire or with enclosed pale areas variable in number and size. Pterostigmal band complete, often narrowed behind M$_{1+2}$, unbranched but outer branch represented by spot of variable extent at margin between M$_3$ and M$_4$. Marginal spot small, usually extending from C to R$_{2+3}$ and sometimes a smaller spot behind R$_{4+5}$. Basal band usually interrupted behind M (as in holotype), less often (in 10 of 54 specimens) complete. Anterior basal spot present, usually extending from R to Cu$_2$. First humeral spot present, ordinarily between C and R, slightly beyond h.

Abdomen of male: Terga 2-5 yellowish brown, corresponding sterna slightly paler, segments 6-9 amber brown; tergal horn on segment 6 short, thick, slightly downcurved, with apical brush of golden hairs on underside. Notal organ only weakly developed, with stiff, decurved black hairs on broad, scarcely protruding median lobe on tergum 3 and a sclerotized peg (ordinarily concealed) on tergum 4. Genital bulb (Fig. 72) broad, slightly wider at greatest width than its length excluding dististyles (the position of which varies). Hypovalves deeply separated, widest near mid-length, tapering gradually toward base and apex; about 10 long, thin, blackened setae along inner margin and on apex of each hypovalve, some twice width of hypovalve. Tergum 9 (Fig. 73) with brush of dark, inwardly curved setae at apex of each posterior lobe, several long, dark setae along mesal margins of lobes; numerous short, nearly erect setae on sides of tergum. Inner, subapical surface of basistyle with 0-4 thick, black setae, often varying in number from one basistyle to the other in an individual. Basistylar flange nearly truncate to broadly and slightly rounded, tilted dorsad at distal end. Outer surface of dististyles slightly convex between base and mid-length; outer one-third curved evenly to densely sclerotized apex. Inner basal cup of dististyle shallow, with darkly sclerotized margin except toward base, with low dorso-mesal tooth and 6-8 short, thick, sharply tipped black setae on dorsal margin near base. Ventral parameres (Figs. 75-79) short, thick, generally about half distance from inner edge of basistyle to mid-line (i.e., closer together than in similar species such as *ferruginea* and *confinis*), extending to end of basistyle, with terminal barbs in some individuals pressed against basal cup of dististyle; free portion longitudinally about half scle-



Figs. 72-78. *Panorpa pachymera*, n. sp. **72,** genital bulb, male holotype, ventral aspect (most hairs omitted). **73,** ninth abdominal tergum, topotypic male paratype. **74,** subgenital plate, female allotype, ventral aspect. **75,** left ventral and dorsal parameres, topotypic male paratype, ventro-mesal aspect to show barbs primarily along dorsal edge of ventral paramere. **76,** same individual, left lateral aspect. **77,** right ventral paramere, ventral aspect, male paratype from Warren Co., Georgia. **78,** genital plate, allotype, ventral aspect. Scale a, figs. 72-74; scale b, figs. 75-78.

rotized, half membranous, strongly bowed ventrad, with 5-7 barbs on outer subapical surface, greater number along inner, dorsal surface, often mostly concealed in ventral aspect. Dorsal parameres brown mesally near base, moderately sclerotized, yellowish brown toward apex, with slightly sclerotized apical appendage bent back toward base of aedeagus. Ventral valves pale, lightly sclerotized. Aedeagal hamulus absent, but broadly V-shaped sclerotized band between ventral parameres somewhat widened near mid-line. Segments 10 and 11 (inserted into 10) and sometimes posterior lobes of ninth tergum visible between bases of dististyles; cerci short.

Abdomen of female: Terga and sterna sordid dark yellowish brown; cerci dark brown to black except membranous areas pale. Subgenital plate broad at base, acutely tipped, with upturned edges a little paler than most of plate (Fig. 74); major marginal and terminal setae long, black, about one-fourth to one-third of greatest width of plate, about 10 in number on each side, 4 on underside just before apex; 7-8 black setae at each side on dorsal surface of plate, near edge, directed mesad (subgenital plate of allotype mounted with dorsal side up to show these setae, which are peculiar to this species). Laterotergites small, concealed in pinned specimens by upturned edges of subgenital plate. Genital plates (Fig. 78) widest near mid-length, with broad posterior lobes on apical plate, their outer margins slanting cephalad and laterad; axial portion not reaching posterior margin in narrow median notch; apodemes moderately divergent.

Body length, male, about 9 to 10 mm. (holotype and most males near 10 mm.); female, about 8 to 10 mm. (allotype 9 mm.). Length of fore wing, male, 8.9 to 12.3 mm. (holotype 11.6 mm.); female, 11.5 to 12.6 mm. (allotype 12.0 mm.).

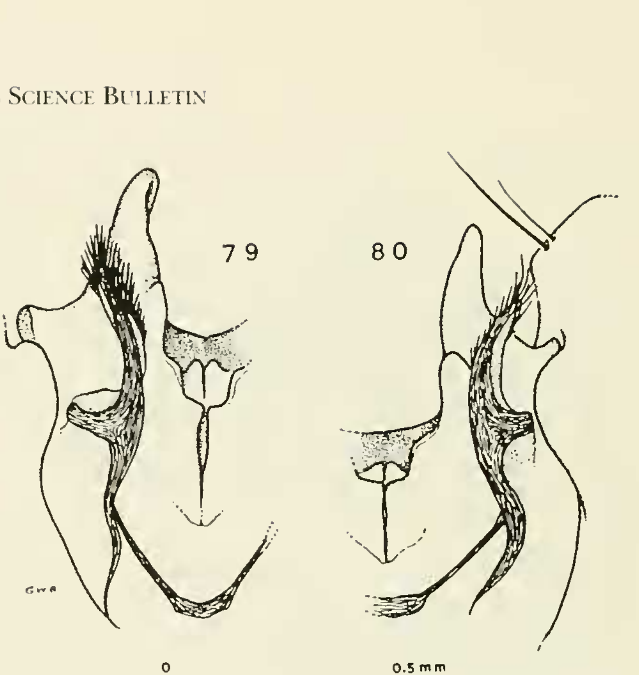
Holotype male, 3 mi. N of Camak, Warren Co., Georgia, 18 May 1989, Wes Bicha. Allotype and 10 male, 1 female paratypes, same data as holotype. Additional paratypes: GEORGIA: Baldwin Co., 1 mi. E of Milledgeville, 15 Sept. 1990, WB (1m); Cherokee Co., 31 Aug. 1991, WB (4m, 1f); Elbert Co., Rose Hill, 8 mi. E of Elberton, 29 May 1978, GWB (2m, 1f); Emanuel Co., 3 mi. W of Coleman's Lake, 19 May 1989, WB (2m); Franklin Co., 1 Sept. 1984, WB (4m); same but 15 Sept. 1991, WB (1m); Gordon Co., 20 May 1986, WB (3m, 2f); Hancock Co., 3 mi. E of Sparta, 15 Sept. 1990, WB (3m); Jefferson Co., 3 mi. W of Wrens, 17 May 1989, WB (1m, 3f); Jenkins Co., 8 mi. W of Millens, 19 May 1989, WB (5m); McDuffie Co., 16 May 1989, WB (2m); Monroe Co., 27 Sept. 1992, WB (1m); Richmond Co., North Augusta, 10-11 May 1989, WB (18m, 3 f); Taliaferro Co., 2 mi. S of Lyneville, 15 Sept. 1990, WB (1m); Upson Co., 27 Sept. 1992, WB (5m). SOUTH CAROLINA: Oconee Co., 1 Sept. 1984, WB (3m).

Holotype, allotype and four paratypes are in the SEM. Other paratypes have been returned to the collector, Wes Bicha.

Most available specimens of *Panorpa pachymera* were collected in spring, but the species also has an autumnal period of emergence, therefore is included here. It is not conspicuously different from *P. ferruginea* of western Georgia and Alabama. The ventral parameres in the male are both longer and thicker than those of *ferruginea* and are set much nearer the mid-line of the aedeagus (as contrasted with close to the inner surface of the basistyle in *ferruginea*), often concealing the dorsal parameres. Also the flange on the basistyle is less prominent than that in *ferruginea* and is more broadly rounded if not plainly truncate. Thick, black setae are present on the inner, ventral apex of the basistyle (but in variable numbers) in *pachymera*, while these are absent in *ferruginea*. The black, inwardly directed setae on the dorsal edges of the subgenital plate appear to be diagnostic for females of *P. pachymera*.

Wes Bicha has collected spring specimens in northern Florida (Santa Rosa Co.) that possibly belong to this species. Because of perceptible differences in male genital structures (compare Figs. 79 and 80) these are not made paratypes of *pachymera*.

The name *pachymera* is derived from Greek (*pachys*, thick + *meros*, a part), referring to the longer, thicker ventral parameres in this species as compared to those of the similar *P. ferruginea*.



Figs. 79-80. *Panorpa pachymera*, n. sp. **79,** left ventral and dorsal parameres and ventral and dorsal aedeagal valves, male paratype from Richmond Co., Georgia. **80,** right ventral paramere and associated structures, male from Santa Rosa Co., Florida, assigned to *pachymera* with some doubt (not a paratype). Scale, both figures.

The occurrence of *Panorpa pachymera* at the type locality (3 miles north of Camak, Warren Co., Georgia) is described by Wes Bicha (in a letter) as "in the most typical southern habitat: on poison ivy and honeysuckle at the edge of a mixed woods." At this site, the woods was chiefly red gum with occasional pines, but with no stream nearby. The open area bordering the woods appeared to be cleared as a right-of-way for an electric power line.

Panorpa acuminata new species

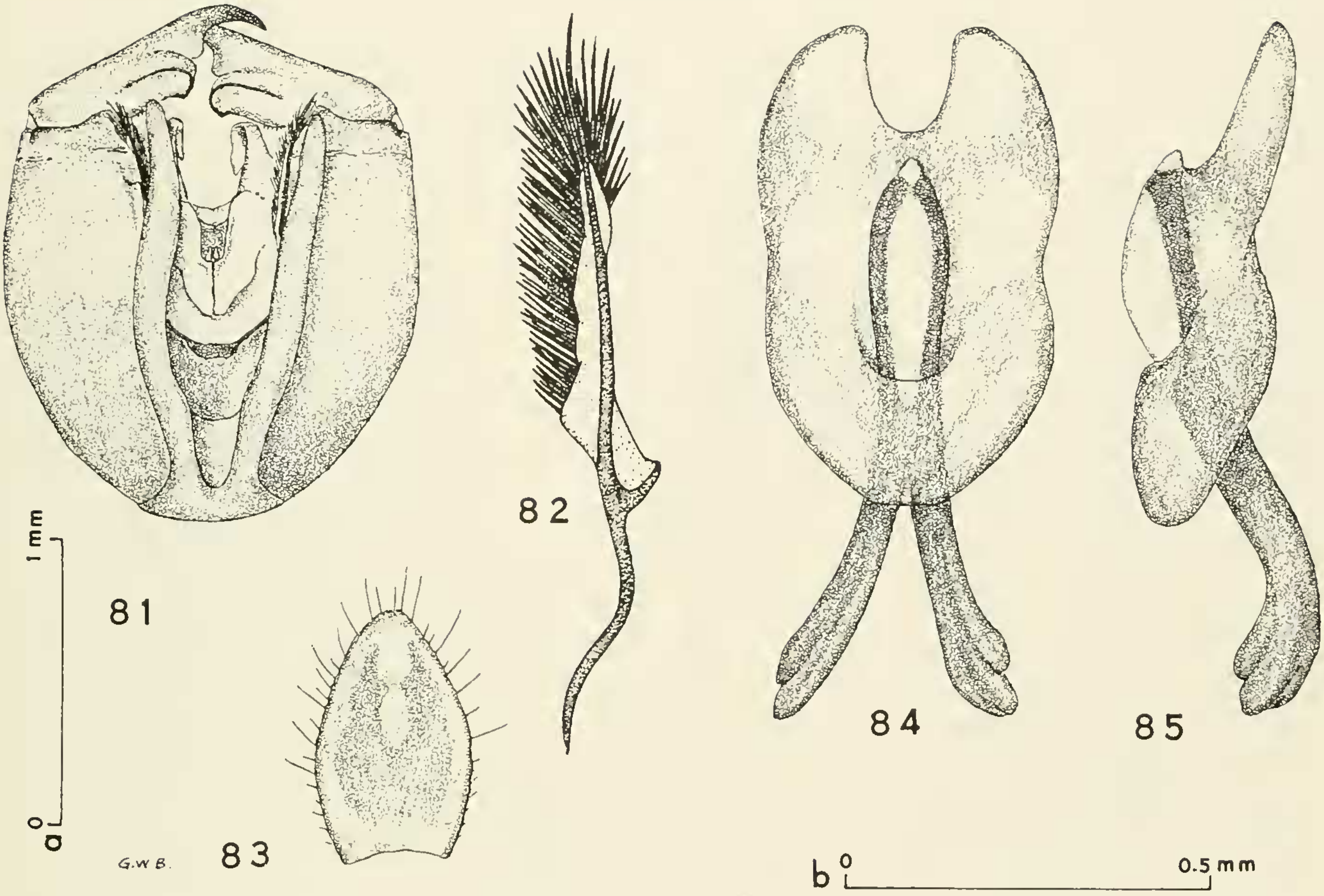
Description based on 39 males, 12 females, pinned.

Head: Dorsum and rostrum unevenly amber brown except for blackened crescent above each ocellus. Palps only slightly darkened apically. Scape, pedicel and approximately basal half of first flagellomere dark yellowish brown; flagellum black, with 38 to 40 flagellomeres (38 in holotype, 40 in allotype, but same variation in both sexes).

Thorax: Dorsum unevenly dark yellowish brown, without markings; pleural surfaces, coxae and mera sordid dark yellowish brown with fine whitish or silvery pubescence on mesothorax and metathorax (visible only at certain angles of illumination) and scattered dark yellowish hairs longest on anterior surfaces of coxae; sparse black hairs among yellow ones on middle coxae. Legs and tarsi yellowish brown with golden-yellow hairs; apical tarsomeres brownish.

Wings tinged with yellowish brown; bands and spots dark brown. Apical band usually entire but with small included pale spot in a few autumnal individuals, two or three small pale spots in those collected in May. Pterostigmal band complete but narrowed behind M_{1+2} (interrupted from M_1 to near M_4 in one female), not forked but distal branch represented by small spot at margin between M_3 and M_4. Marginal spot small, extending from C to R_{2+3}, with a small spot just behind R_{4+5} in a few individuals. Basal band usually broken near mid-length, behind M, but complete by a slender connection in four paratypes. Anterior basal spot and first humeral spot present, latter variable in extent, usually from C to R, slightly beyond h.

Abdomen of male: Terga 2-5 dull yellowish brown (holotype) to sordid dark yellowish brown, corresponding sterna slightly paler,



Figs. 81-85. *Panorpa acuminata*, n. sp. **81,** genital bulb, male holotype, ventral aspect (hairs omitted). **82,** right ventral paramere, ventral aspect, male paratype from Oglethorpe Co., Georgia. **83,** subgenital plate, female allotype, ventral aspect. **84,** genital plate, allotype, ventral aspect. **85,** same, right lateral aspect. Scale a, figs. 81, 83; scale b, figs. 82, 84-85.

segments 6-9 unevenly amber brown; tergal horn on segment 6 slightly downcurved apically. Notal organ weakly developed, with sparse stiff, decurved black hairs on broad, scarcely protruding lobe on tergum 3 and a short, thick median peg (almost knob-like in holotype) on anterior tergum 4. Genital bulb (Fig. 81) about as wide at widest point as its length, excluding dististyles. Hypovalves widest near mid-length, tapering gradually toward base and apex; longer setae along mesal margin and at apex about 12 in number and about twice as long as width of hypovalve. Tergum 9 with posterior lobes parallel, of approximately uniform width throughout, space between them nearly rectangular; apical hairs on lobes yellowish brown, inclined somewhat mesad. Inner, subapical margin of basistyle with 0-2 thick, black setae, usually none (as in holotype) and number sometimes varying from one basistyle to the other in one individual; combinations of setae 0-0 (11 males), 0-1 (2m), 1-1 (4m), 1-2 (4m) and 2-2 (5m). Basistylar flange rounded at apical end, tapering basally. Outer surface of dististyles straight to slightly concave in basal two-thirds, then evenly curved to apex. Inner basal cup of dististyle shallow, inner surface nearly flat to slightly concave, with darkly sclerotized margin except toward base; margin forming blunt dorso-mesal tooth, or angle; 6-9 short, thick, sharply tipped black setae on dorsal margin of cup near base of dististyle. Ventral parameres (Fig. 82) long, slender, with acuminate tips extending to or beyond ends of terminal barbs, curved slightly laterad near apex in several males, including holotype; small group of 6-8 barbs on outer, subapical surface of paramere, greater number (30 or more) along inner edge, in two rows. Dorsal parameres yellowish brown near base, paling to translucent yellowish near tips, with lightly sclerotized apical appendage bent back toward base of aedeagus. Ventral valves yellowish brown, with thin ridge extending along either side of notch containing small, pale dorsal valves and merging with bases of dorsal parameres. Aedeagal hamulus absent, but broadly V-shaped, sclerotized band connecting ventral parameres somewhat thickened medially. Segments 10 and 11 often protruding ventrad between dististyles; cerci inconspicuous.

Abdomen of female. Terga and sterna unevenly dark yellowish brown to brown, with short, yellow setae. Subgenital plate (Fig. 83) wide and long, apex acute to narrowly rounded (allotype); longest marginal setae about one-fourth greatest width of plate, 6 to 8 along each side, 4-6 on underside shortly before apex. No laterotergites, but cuticle near base of subgenital plate continuous with sclerotized folds partially enclosing genital plates. Apical and basal genital plates of about same width (Figs. 84, 85); axial portion not extending to posterior margin; apodemes moderately divergent.

Body length, male, about 9.5 to 13 mm. (holotype 12 mm.); female, about 9-12 mm. (allotype 11 mm.). Length of fore wing, male, 10.0 to 12.8 mm. (holotype 11.6 mm.); female, 10.3 to 12.4 mm. (allotype 11.5 mm.). In general, females are smaller than males, and spring males are slightly larger than autumnal ones.

Holotype male and allotype (mating pair) collected 8 miles west of Greensboro, in the Oconee National Forest, Greene Co., Georgia, 1 October 1977, G. W. Byers (field cat. Greene Co. no. 1). Paratypes: GEORGIA: Baldwin Co., 1 mi. E of Milledgeville, 15 Sept. 1990, WB (1m); Banks Co., 1 mi. W of Homer, 1 Sept. 1991, WB (5m); Clarke Co., Athens, N. Oconee River, 2 Oct. 1977, GWB (1m, 3f); Clarke Co., Athens, 27 Apr., 16 & 17 May, 20-26 May in Malaise trap), -July (6m); Greene Co., same data as holotype (3m, 3f); same, but 3 Oct. 1977, GWB (6m, 3f); Greene Co., along Oconee River, Oconee National Forest, 3 Oct. 1977, GWB (1m); Greene Co., 14 Sept. 1980, WB (1m); Gwinnett Co., 3 mi. W of Loganville, 3-4 May 1980, WB (3m); same, but 14 Sept. 1980, WB (1m); Hall Co., 1 Sept. 1991, WB (1m, 1f); Henry Co., in sticky trap, June 1978, W. Morrill (2m, 3f); Jackson Co., 10 mi. NW of Jefferson, beside U.S. hwy. 129, 28 May 1978, GWB and C. W. Young (4m); Jackson Co., 1 mi. E of Commerce, 16 Sept. 1990, WB (1m); Madison Co., NW of Neese, 2 Sept. 1976, C. K. Starr (1m); Morgan Co., 11 mi. W of Madison, 1 Oct. 1977, GWB (1f); Morgan Co., Hard Labor Creek State Park, 31 Aug. 1984, WB (2m); Oconee Co., N edge Oconee Nat. Forest, 5 and 15 Sept. 1980, WB (2m); Oglethorpe Co., 3 mi. SE of Lexington, 4 Oct. 1977, GWB (1m); Oglethorpe Co., hwy. 22 1 mi. S of Little Creek, 15 Sept. 1990, WB (2m); Rockdale Co., 28 April 1991, WB (3m, 1f); Taliaferro Co., 2 mi. S of Lyneville, 15 Sept. 1990, WB (2m).

Holotype, allotype and most paratypes are in the SEM; 8 paratypes in WB collection; paratypes also deposited in the USNM and MCZ.

Panorpa acuminata closely resembles *P. rupeculana* and *P. pachymera* in both structure and color. Its known range is adjacent to that of *pachymera*, and the two ranges meet in Baldwin and Taliaferro counties, Georgia. *P. acuminata* differs from *pachymera* most noticeably in the males' ventral parameres, which are longer but more slender than those of *pachymera*, are not bowed ventrad (except slightly at base of free portion), have more numerous and thinner barbs and have the acuminate, sclerotized tip extending as far as or (usually) beyond the longest terminal barbs (Fig. 82). The ventral parameres are long and slender in the similar *P. robusta* but in that species are bowed ventrad (or laterad, depending on postmortem drying) and bear much shorter, more slender barbs not in perceptible rows. The most similar ventral parameres are in *P. rupeculana*, but males of that species have four thick, black setae on each basistyle, as well as other differences (see *P. rupeculana*).

Panorpa acuminata takes its name from the ventral parameres of the male (Latin *acuminata* = tapered to a slender point).

The holotype, allotype and several paratypes were collected from the upper leaves of clumps of honeysuckle 2-3 feet high, in a woods of pine, oaks, red gum, hickory and dogwood. While honeysuckle was abundant at this site, its usual ecological associates in the Southeast, namely, brambles and greenbriars, were only occasional or rare; and poison ivy was less common than in most such situations, occurring in scattered, limited areas where woodbine (Virginia creeper) was equally abundant. The initial collection at the type locality was made after sunset (6:50-7:25 EDST). Under twilight but hot (84°F.) and humid conditions, males of both *P. acuminata* and *P. oconee* were "calling." That is, they held their wings somewhat outspread and the genital bulb as high as possible, the position associated with dispersal of sex-attractant pheromone.

How this species and the similar *P. pachymera* are related remains to be studied. The two forms are generally geographically separated and are consistent in structure within their respective ranges. Individuals with intermediate characteristics have not been found.

Panorpa rupeculana new species

Description based on 9 males, 4 females, pinned.

Head: Dorsum, frons and rostrum amber brown except black ring around each ocellus; mouthparts amber brown, tips of apical segments of maxillary palps darker brown. Scape, pedicel and basal two-thirds of first flagellomere yellowish brown; flagellum blackish brown, with 38 flagellomeres in both male and female.

Thorax: Dorsum unevenly brown (some mottling clearly due to post-mortem changes) without markings; pleural surfaces, coxae and mera unevenly light brown with fine whitish to silvery pubescence on mesothorax and metathorax, scattered yellowish setae longest and most numerous on anterior surfaces of coxae; a few black setae on anterior surfaces of middle coxae and apical edges of hind coxae. Legs yellowish brown, tibiae somewhat paler than femora; tarsi darker, brown on tarsomeres 4 and 5.

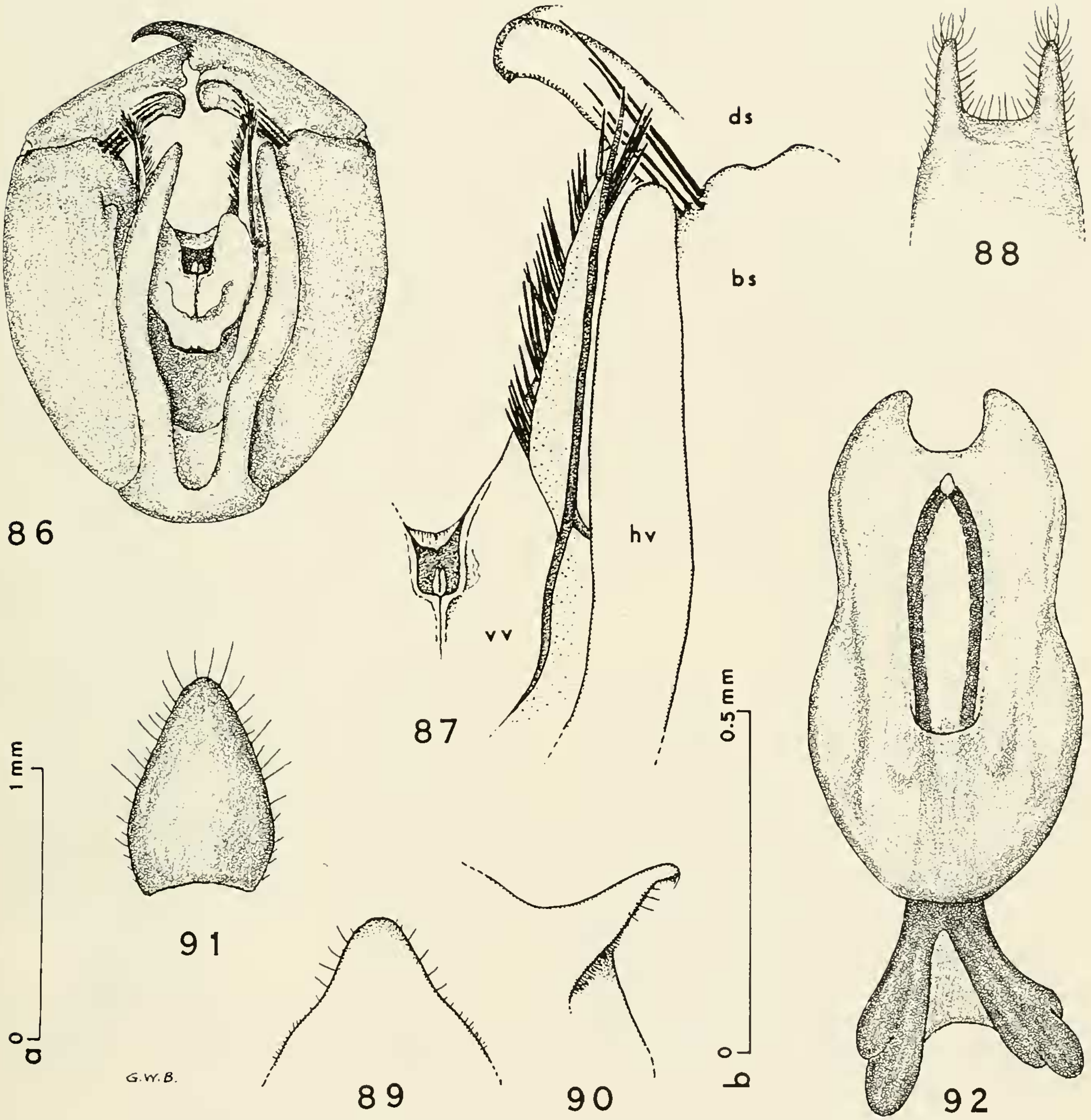
Wings tinged with yellowish brown, bands and spots brown to dark brown. Apical band complete but including marginal pale band from R_3 to behind M_1 in both sexes, pale area less extensive to absent in hind wings. Pterostigmal band complete, slightly narrowed behind M_{1+2}, unbranched but with outer branch suggested by spot at margin between M_3 and M_4 (holotype), extending to M_2 in female. Marginal spot from C to behind R_{4+5}, surrounding nygma (holotype), interrupted between R_{2+3} and R_{4+5} in other specimens. Basal band interrupted near mid-length, approximately M to Cu_1. Basal spot from R or M to Cu_2. First humeral spot from C to R, slightly beyond h.

Abdomen of male: In dried specimen, terga and sterna 2-6 unevenly sordid brown, dark yellowish brown in life, segments 7 and 8 more evenly dark amber brown, genital bulb amber brown; in holotype, tergal horn broad at base in dorsal aspect (narrower in paratype), slender in lateral aspect (Figs. 89, 90). Notal organ slightly developed: posterior margin of tergum 3 not noticeably produced, hairs decurved but neither thickened nor darkened; thick peg on anterior tergum 4 (barely visible in posterior aspect in holotype). Genital bulb (Fig. 86) about as wide as its length measured to ends of basistyles. Hypovalves deeply separated, of nearly uniform width throughout, narrowed only slightly near apex, with about 18 long setae along mesal margin and at apex of each, some setae twice as long as width of hypovalve. Tergum 9 (Fig. 88) with broadly U-shaped emargination between slender lobes (finger-like in dorsal aspect but flattened), each bearing loose tuft of yellowish hairs apically. Dististyles slightly convex on outer surface of basal two-thirds, then narrowing and curving evenly to acute apex; inner basal cup with narrow, darkly sclerotized margin, except toward base, margin slightly thickened at dorso-mesal angle; dorsal margin with six (or more) short, thick, black, acutely tipped setae. Ventro-mesal apex of each basistyle bearing four long, thick, black setae extending far into cup of dististyle. Ventral parameres (Fig. 87) also extending to cups of dististyles, or farther, overlapping thick setae of basistyles (tips bent dorsad in paratype); only four or five subapical barbs on outer side, about five times as many along mesal side, attached to long-triangular membranous margin; sclerotized band of paramere tapering to acute tip slightly beyond terminal barbs. Dorsal parameres slender, largely concealed by ventral parameres in ventral aspect, yellowish brown at base just above fusion with ventral valves, brown around dorsal valves, translucent yellowish apically, with small dorsal appendage bent back toward base of aedeagus. Ventral valves pale yellowish brown, semimembranous; dorsal valves small, pale. No aedeagal hamulus, but sclerotized band connecting ventral parameres slightly widened near mid-line. Segments 10 and 11 small, extending slightly between dististyles. Cerci small, concealed beneath ninth tergum.

Abdomen of female: Terga and sterna yellowish brown in life; in dried specimen unevenly brown to dark brown; cerci black. Subgenital plate (Fig. 91) subtriangular, narrowly rounded at apex, widest just beyond base. Genital plates (Fig. 92) with short posterior lobes separated by U-shaped notch; outer margins of lobes evenly rounded; basal plate slightly wider than apical plate; axial portion not attaining posterior margin; apodemes thick, moderately divergent (left one bent ventrad in allotype).

Body length, male, 9.1-11.5 mm. (holotype, 11.4 mm.); female, 8.6-10.3 mm. (allotype 10.3 mm.). Length of front wing, male, 10.3-11.6 mm. (holotype, 11.0 mm.); female, 10.6-11.8 mm. (allotype 10.6 mm.).

Holotype male and allotype female, at roadside park (Burns Park) on highway I-40, 7 miles NW of center of Little Rock, Pulaski Co., Arkansas, 22 September 1977, George W. Byers (field cat. no. 1). The park is on both sides of the highway, at the western edge of



Figs. 86-92. *Panorpa rupeculana*, n. sp. **86,** genital bulb, male holotype, ventral aspect (most hairs omitted). **87,** right ventral paramere and associated structures, holotype (bs - apex of basistyle, ds - basal portion of dististyle, hv - right hypovalve, vv - ventral valve of aedeagus). **88,** ninth abdominal tergum, holotype. **89,** tergal horn of sixth abdominal segment, dorsal aspect. **90,** same, left lateral aspect. **91,** subgenital plate, female allotype, ventral aspect. **92,** genital plate, allotype, ventral aspect. Scale a, figs. 86, 88-91; scale b, figs. 87, 92.

North Little Rock. Paratypes: ARKANSAS: Ouachita Co., 8.7 mi. NE of Camden, 24 Oct. 1957, I. J. Cantrall, T. Cohn, D. Eades (1m). LOUISIANA: Morehouse Parish, 13 Sept. 1992, WB (1m). MISSISSIPPI: Choctaw Co., 6 Sept. 1986, WB (1m); Lafayette Co., Puskus Lake, 8 mi. NE Oxford, 23 May 1978, GWB and C. W. Young (1m); Pontotoc Co., 13 Sept. 1992, WB (1m, 3f); Tishomingo Co., 25 May 1986, WB (1m); Webster Co., milepost 211 Natchez Trace Parkway, 6 Sept. 1986, WB (2m).

Holotype, allotype and one paratype are in the SEM; paratypes in the UMMZ, and collection of Wes Bicha.

Panorpa rupeculana at once recalls *P. acuminata* because the ventral parameres in males of both species are long and end in a slender, sharp point. The former, however, has four thick, black setae on each basistyle, while *acuminata* ordinarily has none, or occasionally one or two. The membranous portion of the paramere to which the outer terminal barbs are attached, in *acuminata*, is not present in *rupeculana*. Less apically tapered hypovalves and less conspicuous dorsal parameres in *rupeculana* are other readily noticeable differences. Females of this species differ from those of others in the *rufescens* group by the relatively short posterior lobes on the apical genital plate, as well as by the over-all shapes of the genital plate and subgenital plate. That the known ranges of *rupeculana* and *acuminata* are separated by some 240 miles, or 385 km., the area between having been searched for scorpion-flies, influenced my opinion that the Arkansas specimens represent a separate species.

The name of the species is derived from Latin *rupecula*, the diminutive of *rupes*, a rock (in the sense of a crag or rock cliff, such as the outcrop on the south bank of the Arkansas River from which the city of Little Rock takes its name).

At the type locality, *Panorpa rupeculana* and *P. nuptialis* were found in a small, shaded area about 50 by 20 feet of tangled greenbriar, honeysuckle, brambles, goldenrod, etc., in a woods of oak, hickory, maple, red gum, pine and other trees, in the southwestern part of the park, near the Arkansas River.

Panorpa venosa Westwood

In an earlier paper (Byers, 1962b: 473-474, Fig. 2), I synonymized *P. venosa* with *Panorpa rufescens* Rambur. As explained above under *rufescens*, however, the lectotype of *rufescens* was incorrectly chosen, as apparently it was not one of Rambur's original series; and the name *rufescens* is now limited to a species essentially of northeastern United States. The female lectotype of *P. venosa* (one of two female syntypes, the other now lacking the posterior parts of the abdomen) was collected at some unspecified locality in Georgia. Since, as shown above, there are no fewer than four species of the *rufescens* group that might be expected in Georgia, it became important to examine the genital plates of the lectotype of *venosa* to determine to which form the name should now be applied.

I began with the assumption, possibly incorrect, that a specimen collected in Georgia in the early 1840's or some time prior to that is likely to have been found in the environs of Savannah. The first European settlement in Georgia, Savannah was the early administrative center of the state, and for some decades it was the cultural capital as well. On the basis of geographical position and wing markings (mainly the number and extent of clear areas included within the apical band), specimens collected on Sapelo Island, about 40 miles (64 km.) south of Savannah seemed the most likely to be conspecific with *venosa*. No specimens were available from anywhere nearer Savannah.

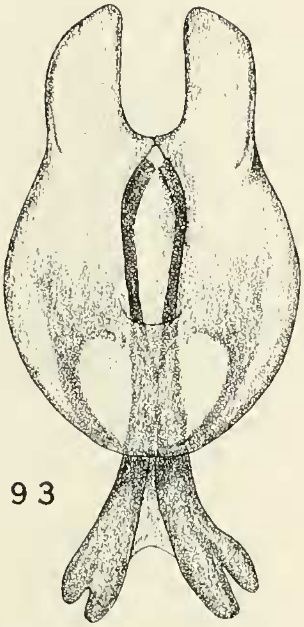
Dr. Stephen J. Brooks of the Natural History Museum, London, kindly removed the posterior segments of the lectotype of *P. venosa* and sent these to me, with permission to make the necessary dissection. The small, smoothly rounded laterotergites beside the ninth abdominal tergum (Fig. 95) somewhat resemble those of *planicola* (Fig. 104) from coastal South Carolina but are smaller and more diagonal in position with respect to the tergum. The subgenital plate of *venosa* (Fig. 96) has the shape seen in more than one other species and is pale apically as in some others, but it also has a broad, almost semicircular basal area without setae. The lateral and dorsal marginal setae (Fig. 95) are much the same as in *planicola*. The genital plate of females from the population on Sapelo Island (Figs. 99, 100) agrees with that of the lectotype of *venosa* except in minor details that, in my opinion, fall easily within the range of intraspecific variation based on that seen in females of other species. At each side of the axial portion of the plate, there is an area of thin, translucent cuticle bordered laterally by a darker zone that fans out posteriorly (this due in part to more densely sclerotized structures on the dorsal side of the basal plate). In addition, there is a rather abrupt narrowing of the apical plate beyond the indistinct end of the basal plate. These characteristics are shared with *P. planicola* (Figs. 105, 106), but in that species the posterior lobes of the apical plate are shorter and wider.

Males of *Panorpa venosa* (Figs. 101, 102) possess many characteristics of the *rufescens* group but most closely resemble those of the more inland *P. acuminata* of north-central Georgia. As in that species, the genital bulb is about as wide as its length excluding the dististyles, the basistyles lack thick, black apical setae (which are sometimes present in *acuminata*) and the ventral parameres are prolonged beyond the ends of the terminal barbs. In details of the ventral parameres, however, *venosa* is conspicuously unlike any other species of the *rufescens* group. The apical 30 per cent of the free part of the ventral paramere has no barbs (Fig. 102), while the more basal portion bears numerous long barbs along its mesal edge. (In a male pinned from alcohol, the ventral parameres twisted in drying, making the barbs somewhat dorsal but still readily visible.) The sclerotized band connecting the ventral parameres is slender, its medial portion nearly V-shaped; and the basistylar flanges are small and bluntly rounded.

Association of males with females that agree in detail with the lectotype of *P. venosa* has only recently been possible, thanks to the cooperation of Dr. Stephen Brooks already mentioned and Dr.Laurent LeSage of Agriculture Canada, who sent the following specimens for identification: GEORGIA, McIntosh Co., Sapelo Island, pan trap in live oak forest, 28 April-9 May 1987, Biosystematics Research Centre, Hymenoptera team (2m, 3f); same except 9-25 May 1987 (2m, 4f); same locality, etc., but collected by flight-intercept trap, 29 May-20 June 1987 (3f); same but in flight-intercept trap in savanna, 29 May-20 June 1987 (1f); same locality but collected from herbaceous growth in oak forest, 29 April 1987, H. Goulet (1m).

Panorpa vernalis Byers

Named *vernalis* because no other *Panorpa* had been taken in early spring in Mississippi (although *anomala* Carpenter was found at the same time as *vernalis*), this species is now known to have an autumnal emergence of adults. On 23 September 1977, I returned to the type locality in Claiborne Co., suspecting there might be a fall generation, and found, in a short time, three males and one female, as well as a few individuals of *anomala*. More recently, I have seen a specimen from East Baton Rouge Parish, Louisiana, collected on 13 November. The species is also known from southern Arkansas, in spring.



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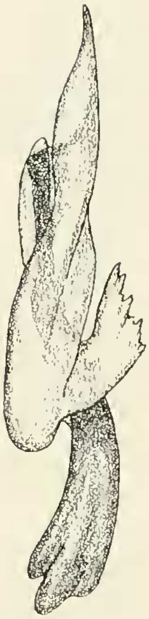

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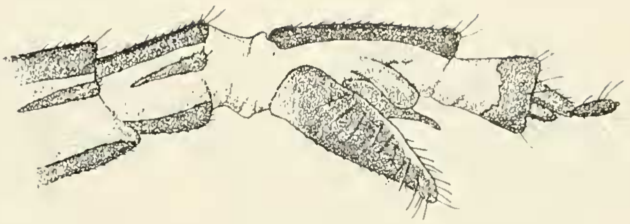

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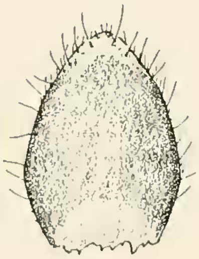

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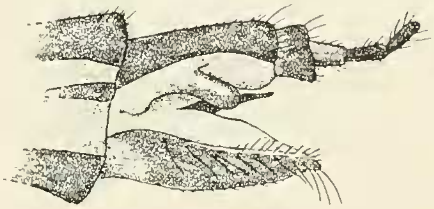

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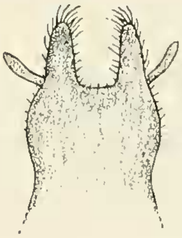

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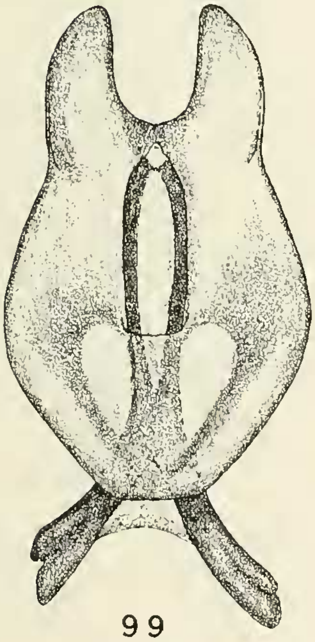

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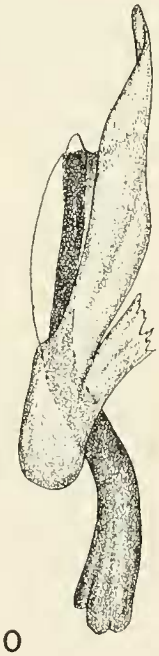

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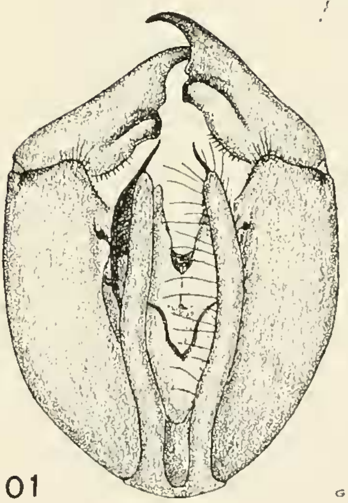

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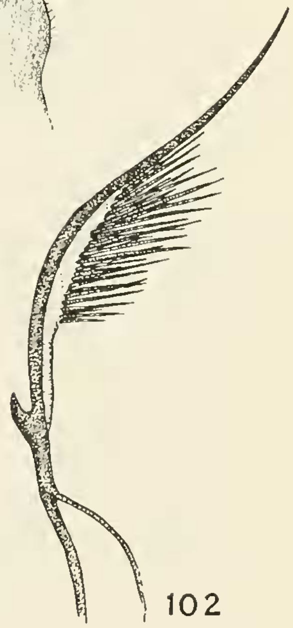

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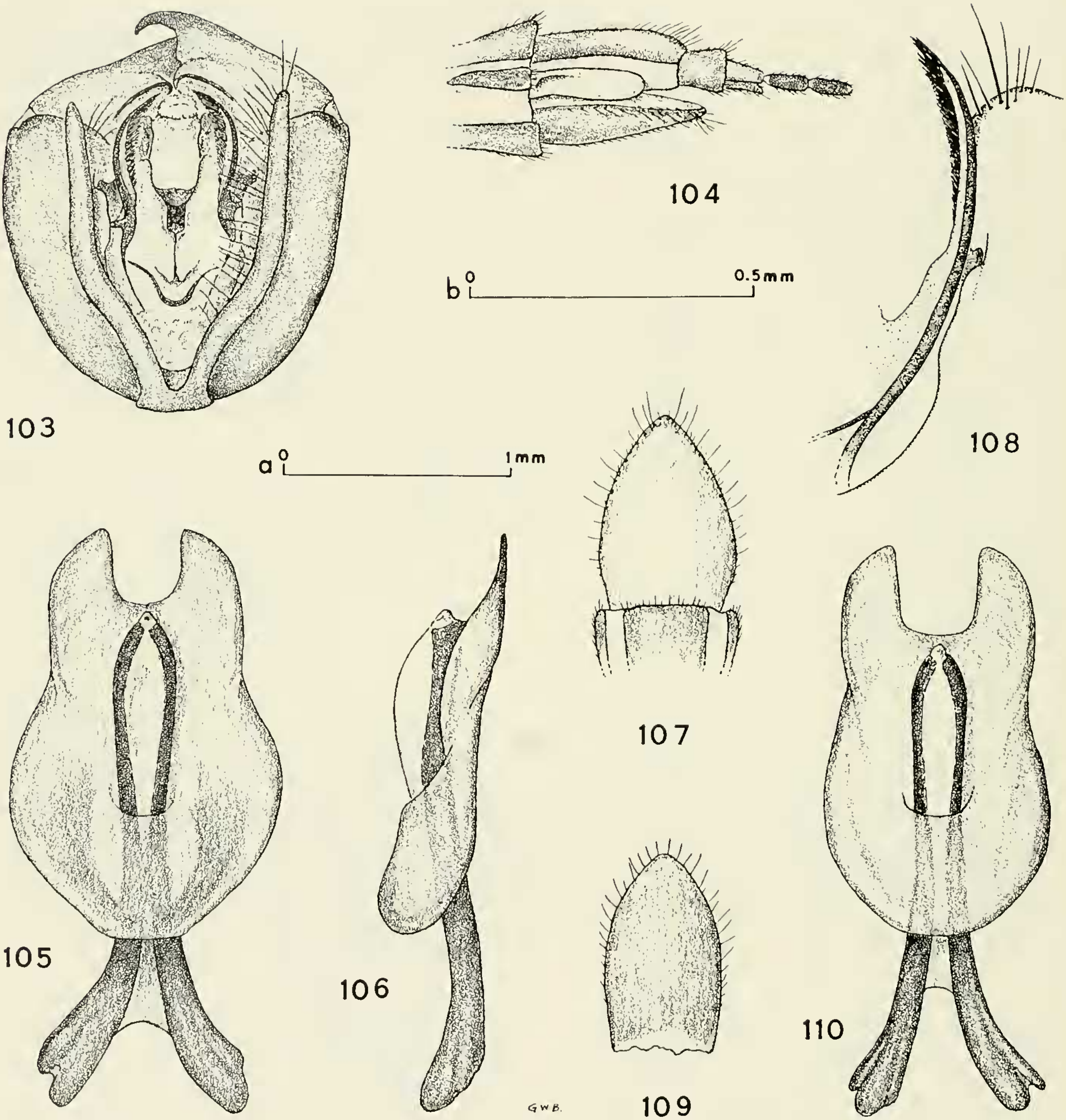
Figs. 93-96. *Panorpa venosa* Westwood, female lectotype. **93,** genital plate, ventral aspect. **94,** same, right lateral aspect. **95,** terminal abdominal segments (7-11), left lateral aspect (extension due to maceration in KOH). **96,** subgenital plate, ventral aspect. **Figs. 97-102.** Specimens from Sapelo Island, Georgia, judged to be *Panorpa venosa.* **97,** terminal abdominal segments, female, left lateral aspect. **98,** ninth abdominal tergum, male. **99,** genital plate, female, ventral aspect. **100,** same, right lateral aspect. **101,** genital bulb, male, ventral aspect. **102,** left ventral paramere, male, ventral aspect. Scale a, figs. 95-98, 101; scale b, figs. 93-94, 99-100, 102.



Figs. 103-107. *Panorpa planicola*, n. sp. **103,** genital bulb, male holotype, ventral aspect. **104,** terminal abdominal segments, female allotype, left lateral aspect. **105,** genital plate, allotype, ventral aspect. **106,** same, right lateral aspect. **107,** subgenital plate, allotype, ventral aspect. **Figs. 108-110.** *Panorpa robusta* Carpenter. **108,** right ventral paramere, male holotype, ventromesal aspect. **109,** subgenital plate, female from Darlington Co., South Carolina. **110,** same female, genital plate, ventral aspect. Scale a, figs. 103-104, 107, 109; scale b, figs. 105-106, 108, 110.

Panorpa planicola new species

Description based on five males, one female, pinned but originally preserved in alcohol.

Head: Dorsum, frons and rostrum, including palps, dark yellowish brown, except apical half of terminal segment of maxillary palps blackish brown and blackened crescent above each ocellus. Scape, pedicel and most of basal flagellomere dark yellowish brown; flagellum blackish brown, with 37 to 39 flagellomeres (holotpype 38).

Thorax: Dorsum sordid yellowish brown, without pattern; pleural surfaces, coxae and mera dull yellowish brown, finely pubescent except small glabrous area beneath each wing base, with scattered pale setae and a few darker setae on anterior surfaces of fore and middle coxae. Legs and tarsi yellowish brown with dark setae; fifth tarsomere darkened apically.

Wings tinged with yellowish brown, bands and spots brown. Apical band including several pale spots, in males, one or two in female. Stigma pale, dull yellow (possibly an artifact of initial preservation), except portion covered by pterostigmal band. Pterostigmal band entire but narrow near mid-length, unbranched, with pale spot included at end of Sc in holotype. Marginal spot present, usually from C to slightly behind R_1 (stops at R_{2+3} in holotype); also spots over cross-vein from R_1 to R_{2+3} and behind R_{4+5}; all cross-veins darkly bordered. Basal band of two spots separated between M and Cu_1. First basal and first humeral spots present, latter extending to R_1.

Abdomen of male: Terga 1-5 unevenly sordid yellowish brown, corresponding sterna slightly paler; segment 6 more evenly dark yellowish brown, with blunt-tipped tergal horn; segments 7-8 yellowish brown, 9 slightly darker. Notal organ a broad, scarcely protruding lobe with downcurved black setae, on third tergum, and a blunt peg on anterior fourth tergum. Genital bulb (Fig. 103) about as wide as its length measured to ends of basistyles. Hypovalves (unnaturally divergent in holotype, although degree of divergence near bases is about as shown) slender, narrow near base then widening slightly for most of length but narrowing again toward apex, extending to or a little beyond ends of basistyles; 6-12 long setae twice width of hypovalve on mesal margin and at apex, other setae shorter. Tergum 9 with two slender, subparallel apical lobes, emargination between them U-shaped. Cerci inconspicuous in most males, concealed by tergum in holotype. Basistyles without blackened, thick apical setae; flange on inner, ventral surface narrow (low), edge nearly straight (holotype) or broadly rounded. Dististyles with shallow inner basal cup bordered by dark brown, strongly sclerotized ridge with dorso-mesal angle, or tooth; row of short, sharply tipped, black setae along dorsal edge of cup near base. Ventral parameres nearly straight, extending beyond ends of basistyles, somewhat flattened, with darkly sclerotized outer edge and shorter, paler inner edge, latter densely set with short, thin barbs increasing in length toward apex of paramere; barbs not in evident rows, longer apical ones extending into cups of dististyles in preserved specimens. Dorsal parameres sclerotized and brown beyond basal fusion with paler ventral valves. Dorsal valves pale, inconspicuous, in notch between darkened inner bases of dorsal parameres. No aedeagal hamulus.

Abdomen of female: All terga and sterna unevenly sordid yellowish brown, sterna slightly paler than terga. Cerci black, their membranous parts white. Subgenital plate (Fig. 107) pointed at apex, only slightly narrowed basally, with evenly dispersed short setae but longer setae on lateral margins and at apex. Laterotergites of ninth segment elongate, rounded posteriorly, pale yellowish brown (Fig. 104). Genital plates (Figs. 105, 106) with posterior lobes broad, emargination between them U-shaped; axial portion not extending to margin of apical plate; apodemes divergent, thick at tips; basal plate thick medially beneath axial portion.

Body length, male, about 10 to 11 mm (holotype approximately 11 mm; abdomen strongly flexed at end of sixth segment); female (allotype) about 11.5 mm. Length of fore wing, male, 10.5 to 11.7 mm (holotype 11.7 mm); female, 12.1 mm.

Holotype male, from Edisto Island, Charleston Co., South Carolina, 29 Oct. 1988, collected by Wes Bicha. Allotype, Givhans Ferry State Park, Dorchester Co., South Carolina, 8 Oct. 1988, WB. Paratypes, all from South Carolina: Edisto Island, Charleston Co., 29 Oct. 1988, WB (3m); Givhans Ferry, Dorchester Co., 28 May 1988, WB (1m).

Holotype, allotype and one paratype in the SEM; other paratypes in collection of Wes Bicha.

This species resembles *P. hispida* and *P. scopulifera* in many details. Males differ from those of *hispida* and *scopulifera* most noticeably in lacking thick, black setae on the inner, ventral apices of the basistyles and in the structure of the ventral parameres. In *planicola*, the barbs are very numerous, mostly short and slender and not in distinct rows along the inner surface of the ventral parameres. *Panorpa hispida*, the range of which contacts that of *planicola*, has fewer and much longer, wider barbs on more curved ventral parameres, and the barbs appear to be in a narrow row on the inner edge of each paramere. In females, the laterotergites of the ninth abdominal segment are similarly pale, swollen, smoothly rounded apically (posteriorly) and elongate in *planicola*, *hispida* and *scopulifera* but are thicker anteriorly in *planicola* than in the other two. There are also evident differences in the shapes of the genital plates (compare figures 47-48, 52-53 and 105-106).

The species takes its name from its general habitat on the coastal plain (Latin *planus*, a plain or flatland, and *colo*, dwell, inhabit). Mr. Bicha reports that *P. planicola* was associated with dense growths of honeysuckle at both localities from which it is known. (Since the honeysuckle was introduced from eastern Asia, one wonders what plant association comprised the native habitat of so many regional species of *Panorpa* that have been found on honeysuckle.) On Edisto Island, the honeysuckle was growing beneath live oaks festooned with Spanish moss (*Dendropogon usneoides*).

Panorpa robusta Carpenter

Described from a single male (Carpenter, 1931:240), this species has remained something of a puzzle. The holotype was from Meredith, South Carolina, a village that ceased to exist some time about 1930 but was near the present town of Manville, in Lee County. Carpenter (1939:164) subsequently reported two males from Dacula (Gwinnett Co.), Georgia. The female has not been described.

In *robusta*, the ventral parameres are the best recognition character, as in males of all species of the *rufescens* group. In the holotype and most other males, these parameres are oriented so that the numerous short, slender barbs are primarily on the dorsal surface, all but concealed in ventral aspect. In ventro-mesal aspect, however, their abundance and distribution can be seen (Fig. 108). The only other named regional species known to me that has so many short, thin barbs not in distinct vertical or longitudinal rows is *P. ensigera* Bicha (1983) from North Carolina. This species differs from *robusta* in having three thick, black setae on the ventromesal apex of each basistyle.

In external appearance, the female of *robusta* resembles that of *P. scopulifera*, particularly in the shape of the subgenital plate (Fig. 109; cf. Fig. 50), but it lacks the conspicuous laterotergites of *scopulifera*. The genital plates in *robusta* (Fig. 110) are shorter in comparison to their anterior apodemes, the distal lobes of the apical plate are more widely separated, the emargination being broadly U-shaped, and the medial part of the basal plate has quite a different shape in the two species.

The only series of *Panorpa robusta* I have seen (5m, 10f) was collected in Darlington Co., South Carolina, near Hartsville, on 26 September 1930, by T. H. Hubbell (his field cat. no. 29). This place is only 20 miles (32 km) northeast of the type locality. On the same day, Prof. Hubbell collected an additional male in Florence Co., near Scranton. Wes Bicha returned to this area in 1992 and found two males, one female in Darlington Co. (16 Oct.) and one male in Florence Co. (17 Oct.); and his son Fred Bicha collected one male in Williamsburg Co. on 18 Oct. Earlier Wes Bicha had found one male in Dorchester Co., on 8 October 1988, and another on 29 October 1988, near U.S. hwy. Alt. 17, 2 mi. E of county line (Edisto River). In the USNM there is a male from Charleston Co., South Carolina, dated "IX.20", from the G. M. Greene collection.

Panorpa ensigera Bicha

Distinctly bivoltine, this species has been found from late May to mid-June and again in September and October. Bicha (1983) originally recorded *ensigera* from Richmond Co., North Carolina, 16 Sept. 1980 and 12-13 June 1981, and from Moore Co., N.C., 16 Sept. 1980. More recently, he has collected truly autumnal specimens of *ensigera* in Lee Co., N.C., 27 Sept. 1986, and Scotland Co., N.C., 15 Oct. 1984 (also 29 May 1988).

UNUSUAL AUTUMNAL RECORDS

There are a few common species with extensive spring-summer periods of emergence for which there are occasional autumnal records. These autumnal occurrences probably represent individuals of late-summer generations that were somehow developmentally delayed, or late-summer weather may have been prolonged in certain years or at particular places. Following are such unusual autumnal records of adult Mecoptera in the Southeast.

Panorpa anomala Carpenter

Most of the geographic range of this species is north of the area under consideration, in Iowa, Wisconsin, Illinois and Michigan; and most date records indicate spring and late summer appearances of the adults, even in Arkansas, Missouri and Mississippi. However, I found *P. anomala* together with *P. vernalis* at Rocky Springs Park, on the Natchez Trace Parkway, Claiborne Co., Mississippi, on 23 September 1977. And I have seen a female specimen from East Baton Rouge Parish, Louisiana, collected on 6 November 1982.

Panorpa insolens Carpenter

Kentucky: Clark Co., Winchester, 15 Oct. 1960 (1f); Fayette Co., 7 Oct. 1954 (1f); Jefferson Co., near Louisville, 7 Oct. 1976 (1m); Knox Co., 11 Oct. 1941 (1f, not dissected, could be *P. helena*); Oldham Co., 21 Sept. 1971 (1m); Rowan Co., Morehead, 16 Oct. 1965 (1f).

Panorpa longicornis Carpenter

North Carolina, Jackson Co. (on Macon Co. line), Whiteside Mountain, 22 Sept. 1937 (1m).

Panorpa nebulosa Westwood

Missouri, Boone Co., near Columbia, 10 Oct. 1953 (1m).

Panorpa speciosa Carpenter

Kentucky, Jefferson Co., Louisville vicinity, 7 Oct. 1976 (1f).

KEY TO AUTUMNAL MECOPTERA OF SOUTHEASTERN UNITED STATES

1. Tarsi with a single, large claw (Family Bittacidae) 2
—Tarsi each with two small claws 3
2. Cross-vein between Sc and R_1 beyond level of first fork of Rs; lobes of tergum 9 of male only slightly longer than basistyles; cerci about half as long as basistyles .... *Bittacus occidentis*
—Cross-vein between Sc and R_1 before level of first fork of Rs; lobes of tergum 9 of male more than twice as long as basistyles; cerci much longer than basistyles .... *Bittacus texanus*
3. Costal cell of fore wing with ten or more cross-veins beyond humeral cross-vein; body slightly depressed; head strongly opisthognathous (Family Meropeidae) .... *Merope tuber*
—Costal cell without cross-veins beyond humeral cross-vein; body not depressed; head prolonged ventrad as a rostrum, hypognathous (Family Panorpidae, genus *Panorpa*) 4
4. Hypovalves of sternum 9 of male less than one-third length of genital bulb excluding dististyles and borne on prolongation of sternum on ventral surface of bulb; tergum 9 narrowed toward subacute apex, without posterior lobes; genital plates of female without posterior lobes on apical plate, axial portion thick, its apodemes only slightly divergent (*lugubris* group) 5
—Hypovalves of sternum 9 deeply separated, from two-thirds as long as genital bulb to slightly exceeding ends of basistyles; tergum 9 with two posterior lobes (broadly truncate in one regional, montane species not of autumnal occurrence); apical genital plate of female with two narrow to wide posterior lobes, axial portion usually less than one-third width of plates, with moderately to widely divergent apodemes 8
5. Wings mostly black, with few small, white spots .... *P. lugubris*
—Wings tinged with yellowish brown, bands and spots brown 6
6. Wings lightly tinged with yellowish brown; pterostigmal band diagonal, unbranched; basal band strongly constricted at M; humeral area of wing clear, without humeral spots .... *P. floridana*
—Wings strongly tinged with yellowish brown; pterostigmal band branched or, if unbranched, wide; basal band rarely constricted near mid-length; humeral area of wing darkened, pigmented area connected to first basal spot 7
7. Dark band along posterior margin of wing from basal band to wing base; pterostigmal band broad, not branched .... *P. nuptialis*
—Dark band along anterior edge of wing from basal band to wing base; pterostigmal band usually branched, its outer or distal branch often joining apical band near wing margin .... *P. rufa*
8. Inner basal cups of dististyles of male directed more or less mesad, deep, with wide flange-like borders; hypovalves slender, extending to ends of basistyles or farther (cf. *longicornis*); ventral parameres nearly straight, extending between dististyles; aedeagal hamulus conspicuous, blunt-tipped; basal plate of female genital plates narrower than apical plate; laterotergites strongly sclerotized, their outer surfaces convoluted (*virginica* group) 9
—Inner basal cups of dististyles shallow, without wide flange-like borders, directed basad or ventrad; hypovalves of variable length; ventral parameres not reaching beyond cups of dististyles, or, if longer, strongly curved (except in *longicornis*); basal plate of female genital plates as wide as or wider than apical (distal) plate; laterotergites, if present, only moderately sclerotized, their outer surfaces smooth (or longitudinally folded in dried specimens) 12
9. Ventral parameres stout and long, extending beyond ends of dististyles, often in contact in apical one-third (Fig. 17); ventral margin of inner basal cup of dististyle prolonged mesad as two prominent points, basal one longer than wide; distal one less narrow; laterotergites of female expanded ventrally beneath sides of subgenital plate (Fig. 21); axial portion of genital plates only slightly prolonged cephalad from basal plate (Fig. 22) .... *P. choctaw*
—Ventral parameres extending only to ends of dististyles, or shorter, apical ends well apart; ventral margin of cup of dististyle irregular (jagged) or with projections about as wide as their length; laterotergites as in *choctaw* or altogether lateral; axial portion of genital plates prolonged cephalad more than half length of plates alone 10
10. Ventral parameres of male extending only into basal cups of dististyles (Fig. 11) .... *P. neglecta*
—Ventral parameres extending to tips of dististyles 11
11. Ventral margin of cup of dististyle smooth; angular projections about as wide as long (Fig. 13) .... *P. oconee*
—Ventral margin of cup jagged; angular projections wider than long .... *P. virginica*
12. Wings strongly tinged with yellow to yellowish brown, with three broad, transverse, dark brown bands (apical, unbranched pterostigmal, uninterrupted basal bands, width of each at mid-length equal to 10% or more of wing length), a small marginal spot, and joined first basal and first humeral spots .... *P. americana*
—Wing membrane colorless to tinged with yellowish brown; bands and spots brown to dark brown; bands, if present, narrower with irregular edges; basal band often interrupted near mid-length; first basal and first humeral spots not joined 13

13. Sixth abdominal segment of male without posterodorsal horn; wings with spots only (no bands), pterostigmal spot often roughly triangular; axial portion of genital plates of female protruding beyond posterior margin of apical plate, apodemes large, widely divergent .... *P. nebulosa*

—Sixth abdominal segment of male with posterodorsal horn; wings with bands and spots or spots only, pterostigmal spot not triangular; axial portion of female genital plates not reaching posterior margin of apical plate, apodemes variable 14

14. Dististyles of male with subrectangular projection on ventral surface near base; ventral parameres slender, extending to tips of dististyles or beyond; pterostigmal band branched; apical genital plate of female with slender posterior lobes curved mesad; no apodemes projecting cephalad from basal plate .... *P. longicornis*

—Dististyles of male without rectangular projection from ventral surface; ventral parameres not extending to tips of dististyles; genital plates of female usually with projecting anterior apodemes, if not, pterostigmal band interrupted, incomplete; posterior lobes of apical (distal) plate wide 15

15. Aedeagal hamulus present, in male; ventral parameres extending beyond basal cups to mid-length of dististyles; posterior lobes of distal plate in female more than twice as long as their basal width, space between them as wide as deep 16

—Aedeagal hamulus absent, in male; ventral parameres short, not reaching beyond basal cups of dististyles; posterior lobes of distal plate in female about twice as long as their basal width, or less, space between lobes deeper than wide 17

16. Fore wings without humeral spots; aedeagal hamulus with two long, acuminate upturned points (Fig. 23); ventral parameres unbranched, with closely-set barbs along mesal edge .... *P. bichai*

—Fore wings with both humeral spots; aedeagal hamulus broadly U-shaped, the two points acute or narrowly rounded; each ventral paramere with two long, slender branches; barbs on dorsal branch and base of ventral branch widely separated .... *P. bifida*

17. Wings with two humeral spots, the second rarely faint 18

—Wings with only one (first) humeral spot, or none 21

18. Ventral parameres of male two-branched; basal plate of female genital plates crescent-shaped, covered ventrally by thick, sclerotized cuticular folds except along mid-line 19

—Ventral parameres with tufts of barbs but no branches; basal plate not distinctly separate from apical plate; no sclerotized folds of cuticle below genital plates 20

19. Ventral or lateral, shorter branch of each ventral paramere terminating in tuft of long barbs (or two tufts slightly separated); anterior apodemes of female genital plates (i.e., part before basal plate) about 35% of length of entire structure .... *P. anomala*

—Ventral branch of ventral paramere with numerous short barbs, but without terminal tuft(s) of barbs; apodemes of female genital plates short, less than one-fourth (17-23%) of length of entire structure .... *P. speciosa*

20. Ventral parameres short, curved, not extending between dististyles, with two tufts of short barbs on apical enlargement; apical genital plate of female with broad posterior projections .... *P. braueri*

—Ventral parameres long, extending slightly between dististyles, nearly straight, with basal tuft of barbs from semimembranous expansion on mesal side of paramere and two divergent tufts of long barbs at and near apex; apical genital plate of female with slender posterior projections .... *P. isolata*

21. Inner basal cups largely on ventral (posterior) surface of dististyles (Figs. 30, 31); ventral margin of cup usually irregularly serrate and set laterad, concave inner surface of cup facing ventrad or nearly so; genital plates of female without apodemes extending anteriorly from basal plate (Figs. 38, 40) (*banksiana* group) 22

—Inner basal cups of dististyles facing toward region between basistyles, toward aedeagus; genital plates of female with conspicuous anterior apodemes 24

22. Ventral parameres without barbs, broad at base (as wide as hypovalves), attenuate toward slender apex, extending almost to ends of dististyles (Fig. 30); basal cup of dististyle as wide as long; genital plates of female (Carpenter, 1931, fig. 53) narrowly rounded anteriorly .... *P. banksiana*

—Ventral parameres with barbs along most of mesal edge, not broad at base; basal cup of dististyle oblong, narrower than long; anterior end of genital plates of female wide, scarcely rounded 23

23. Ventral parameres strongly bowed, tips broadly overlapping (Fig. 31); basal cup of dististyle not divided by a carina; genital plates of female almost truncate anteriorly (Fig. 38) .... *P. gracilis*

—Ventral parameres slightly curved, not enough to overlap apically; basal cup of dististyle divided by a diagonal carina; genital plates of female broadly bilobed anteriorly (Fig. 40) .... *P. palustris*

24. No complete bands or large spots on wings; most cross-veins conspicuously bordered with dark pigmentation, borders wider than cross-veins .... *P. vernalis*

—Both apical and pterostigmal bands usually complete (but pale spots may be enclosed by apical band); cross-veins not conspicuously bordered 25

25. First humeral spot absent (rarely present but faint); pterostigmal band complete, not conspicuously narrowed behind M_{1+2}; cross-veins not bordered; basal cup of dististyles without darkened angle or tooth on dorso-mesal margin; apical plate of female genital plates with slender posterior lobes about twice as long as width at base .... *P. insolens*

—First humeral spot present; pterostigmal band narrowed behind M_{1+2} or rarely interrupted; some cross-veins narrowly bordered; basal cups of dististyles with darkened angular tooth on dorso-mesal margin; apical plate of female genital plates with posterior lobes only slightly longer than width at base, or shorter (*rufescens* group) 26

26. Ventral parameres short, free (apical) portion of each extending only slightly beyond adjacent basistylar flange, apical barbs not reaching ends of basistyles (Figs. 49, 54, 65) 27

—Ventral parameres longer, free portion of each usually extending beyond ends of basistyles, apical barbs often extending into cups of dististyles (Figs. 42, 72, 81, 86) 29

27. Ventral parameres with barbs along mesal side only (Fig. 49); laterotergites of female ninth segment conspicuous, evenly rounded posteriorly .... *P. scopulifera*

—Ventral parameres with some barbs on outer subapical edge; laterotergites absent or concealed by subgenital plate 28

28. Sclerotized band in free portion of ventral paramere extending to or among apical barbs (Fig. 54, 55); usually no thick, black setae on ventro-mesal apex of basistyle (rarely 1 or 2); female without laterotergites on ninth segment of abdomen .... *P. ferruginea*

—Sclerotized band not reaching end of free portion of ventral paramere (Fig. 66); 2-4 thick, black setae on ventro-mesal apex of each basistyle; female with small laterotergites usually concealed by upturned edges of subgenital plate .... *P. confinis*

29. Barbs of ventral parameres short, slender, on dorsal or mesal surface of paramere (Figs. 103, 108), numerous and not clearly in rows 30

—Barbs on ventral parameres long, readily visible in ventral aspect, on mesal edge only or on both sides but fewer on outer edge than along mesal edge 32

30. Ventral parameres bowed laterad, barbs primarily on mesal surface (Fig. 103); basal plate of female genital plates conspicuously wider than apical plate; pale (thin) areas in basal plate at either side of axial portion (Figs. 105, 106); laterotergites present (Fig. 104) .... *P. planicola*

—Ventral parameres bowed ventrad, barbs primarily on dorsal surface (Fig. 108); basal plate of female genital plates only slightly wider than apical (distal) plate (Fig. 110); laterotergites absent 31

31. Three or four thick, black setae on ventro-mesal apex of each basistyle, in male; ventral parameres protruding conspicuously from genital bulb; axial portion of genital plate of female extending beyond posteromedial margin of distal plate .... *P. ensigera*

—No thick, black setae on ventro-mesal apex of basistyle; ventral parameres not protruding or scarcely protruding from genital bulb; axial portion of genital plate of female not extending to posteromedial margin of distal plate (Fig. 110) .... *P. robusta*

32. Ventral parameres wide, flattened, bowed laterad, with long barbs along mesal edge only (Fig. 42); females with moderately sclerotized laterotergites having smooth outer surface (may be folded in dried specimens) .... *P. hispida*

—Ventral parameres slender, straight or broadly sinuous, or short, thick and bowed ventrad, with few subapical barbs on outer (lateral) edge, greater number along mesal edge; laterotergites absent or small and usually concealed in dried specimens 33

33. Free portion of ventral parameres short, thick, about half distance from basistyle to mid-line (Fig. 72), bowed ventrad, with apical barbs often extending into cups of dististyles; laterotergites of female small, usually concealed by upturned edges of subgenital plate; 7 or 8 setae at each side on infolded dorsal edge of subgenital plate directed mesad .... *P. pachymera*

—Free portion of ventral parameres long, slender, set near mesal surface of basistyle, with sharp, sclerotized apex extending among apical barbs or beyond (Figs. 82, 87); laterotergites small and apically rounded (Fig. 95) or absent but with moderately sclerotized cuticular folds beneath ninth tergum turned inward around base of genital plates; no mesally directed setae on upper edges of subgenital plate 34

34. Ventral paramere without barbs on apical 30 per cent of free portion; barbs long, some 30 per cent as long as free portion of paramere (Fig. 102); laterotergites of female small, rounded apically (Fig. 95) .... *P. venosa*

—Ventral paramere with barbs extending to or nearly to tip; barbs shorter, longest ones less than 25 per cent of length of free portion of paramere (Figs. 81, 86); laterotergites not noticeably developed on ninth abdominal segmentof female 35

35. Four thick, black setae on ventro-mesal apex of each basityle (Fig. 86); known range in Arkansas .... *P. rupeculana*

—Usually no thick, black setae on basistyle (rarely 1 or 2) (Fig. 81); known range in Georgia .... *P. acuminata*

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